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CONTINUING MEDICAL EDUCATION

Screening, early detection, and trends for melanoma: Current status (2000-2006) and future directions

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In the past 5 years, there have been notable strides toward the earlier recognition and discovery of melanoma, including new technologies to complement and augment the clinical examination and new insights to help clinicians recognize early melanoma. However, incidence and mortality rates throughout most of the developed world have risen over the past 25 years, while education and screening, potentially the best means for reducing the disease, continue to be severely underutilized. Much progress needs to be made to reach middle-aged and older men and persons of lower socioeconomic status who suffer a disproportionate burden of death from melanoma. Worldwide melanoma control must also be a priority, and comprehensive educational and screening programs should be directed to Northern Ireland and a number of Eastern European nations, whose 5-year survival rates range between 53% and 60%, mirroring those of the United States and Australia more than 40 years ago.

Learning objective: After completing this learning activity, participants should be aware of the most recent melanoma epidemiologic data, both in the United States and internationally; worldwide early detection and screening programs; clinical strategies to recognize and improve the detection of early melanoma; the latest technologies for early detection of melanoma; and public and professional education programs designed to enhance early detection. (J Am Acad Dermatol 2007;57:555-72.)

elanoma is an increasingly common cancer in the United States and elsewhere. Screening and early detection programs can ideally detect nearly all melanoma at a curable and early stage. In this review, we highlight emerging national and international incidence and mortality trends, advances in clinical strategies for the detection of early melanoma, worldwide screening and educational programs, new technologies for early identification of lesions, and public and professional education to promote early detection of disease.

We reviewed MEDLINE and national and international registries and databases using search terms such as melanoma, incidence, mortality, early detection, screening, physical exam, sensitivity,

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Abbreviations used:

AAD: American Academy of Dermatology ABCD: asymmetry, border irregularity, color,

and diameter

ACS: American Cancer Society
BSCT: Basic Skin Cancer Triage
CAMS: classic atypical mole syndrome
CNMD: Consensus Net Meeting on

Dermoscopy

CI: confidence interval DNdysplastic nevi FDR: first-degree relatives general practitioner GP: HRNCAMS: high-risk non-CAMS IOM: Institute of Medicine lentigo maligna melanoma LMM: NM: nodular melanoma

NMSC: nonmelanoma skin cancer

OR: odds ratio

PCP: primary care provider
PLC: pigmented lesion clinic
QALY: quality-adjusted life year

SEER: Surveillance, Epidemiology, and End

Results

SES: socioeconomic status SSE: skin self-examination

SSM: superficial spreading melanoma

specificity, screening, self-screening, identification, recognition, and dermoscopy/dermatoscopy. We identified additional studies by reviewing the reference lists of all studies included herein and consulted

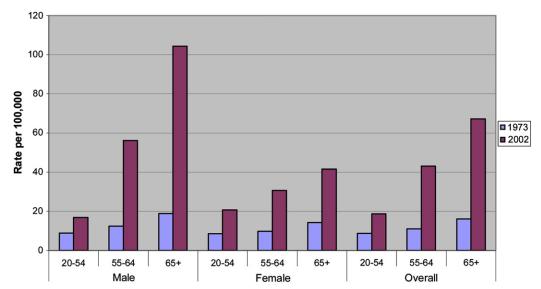


Fig 1. Melanoma incidence among non-Hispanic whites, 1973 and 2002, by age and gender. (Data taken from the Surveillance, Epidemiology, and End Results [SEER] Program SEER*Stat Database. Incidence - SEER 9 Regs Public Use [1973-2002], National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released April 2005, based on the November 2004 submission. Available from www.seer.cancer.gov).

with experts to ensure that all relevant studies were covered. Every effort was made to use only the most recently published studies (2000-2006); in some cases, key studies before 2000 were included.

INCIDENCE AND MORTALITY TRENDS IN THE UNITED STATES AND INTERNATIONALLY

The American Cancer Society (ACS) estimates that there will be 59,940 cases of melanoma in the United States in 2007 (33,910 cases in males, and 26,030 cases in females). Estimates also indicate that there will be 8110 melanoma deaths (5220 in males; 2890 females).¹

Incidence trends

Both in the United States and throughout most of the world, the incidence of melanoma has been increasing steadily over the past few decades. In fact, in the United States, the overall age-adjusted incidence among non-Hispanic whites has increased from 7.5 cases per 100,000 in 1973 to 21.9 cases per 100,000 in 2002, an increase of nearly 200%, with disproportionate increases in persons over the age of 55 years. Two-thirds of all melanomas diagnosed in the United States between 1988 and 1999 were <1 mm, while the proportion of ≥ 2 mm lesions (14.4% to 15.5%) has remained the same.

Incidence rates between 1973 and 2002 have risen in all age groups and in both men and women; however, men between the ages of 55 and 64 years

have experienced more than a 4-fold increase (12.4) to 56.1 per 100,000), and rates have risen more than 5-fold in men aged 65 years and older (18.8 to 104.4 per 100,000; Fig 1). One study contended that the higher numbers of biopsies among the Medicare population in recent years are the cause for these rates, rather than true increases in incidence. 4 Recent data from New South Wales (Australia)⁵ indicates stabilizing incidence rates in younger men and declining rates in younger women. In this data, only men aged 75 years and older show increasing incidence rates (7.2% per year). In Sweden, the overall incidence rates remained stable for 1990 through 1999, with declining rates in younger and female patients offset by lack of progress for older patients, men, and individuals with truncal lesions and nodular melanoma.6

In the United States, the incidence of melanoma among African Americans and Hispanics is dramatically lower than that among whites; however, rates are slowly increasing in these groups as well. From 1992 to 2002, incidence among black males increased from 0.58 to 1.00, and in black females increased from 0.58 to 0.95. Among Hispanic males, incidence increased from 3.11 in 1992 to 4.68 in 2002. Melanoma incidence among Hispanic women increased from 3.38 to 4.05 during this same period.²

In Scotland (1979-1998), the incidence rate rose more sharply in men than women, reversing earlier trends, and occurred in melanomas of all thicknesses in men. In women, only melanomas thinner than

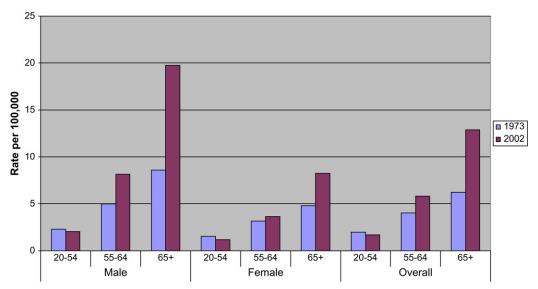


Fig 2. Melanoma mortality among non-Hispanic whites, 1973 and 2002, by age and gender. (Data taken from the Surveillance, Epidemiology, and End Results [SEER] Program SEER*Stat Database. Mortality - All COD, Public-Use with State, Total U.S. [1969-2002], National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released April 2005. Underlying mortality data provided by NCHS [www.cdc.gov/nchs].)

1.5 mm increased in incidence. The most frequent body sites for melanoma include the trunk, head, and neck in men and the legs in females.⁷

De Vries et al^{8,9} analyzed 211,557 incident cases of melanoma recorded during from 1953 to 1998 from 63 European cancer registries. Incidence rates vary significantly depending on the geographic location, with higher rates in northern European countries (such as Norway and Sweden) and lower rates in southern and eastern Europe (such as Poland and Italy). It has been hypothesized that this latitudinal gradient may be related to sun exposure behaviors, and in particular to the tendency for Northern Europeans to vacation in sunny climates, resulting in intense, intermittent sun exposure. Encouragingly, the rate of increase has begun to subside, and in some cases has actually decreased in younger age groups in northern Europe (ie, Denmark, Norway, and Sweden). However, incidence rates continue to rise in older men and women. In addition, in most of the western, eastern, and southern European countries (ie. France, Slovakia, and Slovenia) melanoma incidence continues to increase.

Mortality

In 1973, the mortality rate among non-Hispanic whites in the United States was 2.1 per 100,000; in 2002, this number increased to 2.9 per 100,000.² Since 1992, however, there has been no change in mortality among men and a reduction in mortality among women.

With regard to specific age groups, between 1973 and 2002, melanoma mortality decreased by 23% in women aged 20 to 54 years and by 11% in men in the same age range. In contrast, mortality rates rose 15% in women aged 55 to 64 years and 64% in men of the same age range. Mortality rates increased 130% (8.6 to 19.8 per 100,000) in men aged 65 years or older, and 73% in women of the same age group (Fig 2).²

American states with the highest rates of death from melanoma are New Hampshire, Oklahoma, Maine, Utah, and Idaho (Table I). Specific information on factors that may be associated with state-by-state rates of mortality, such as incidence, dermatology care, social class, rural versus urban residence, and surgical care, are unavailable. Therefore, new attention should be given to developing such databases. It is worth noting that nearly all of the 10 states with highest melanoma mortality are in the bottom third of US population ranking, and only one is among the most populous 25 states.

Worldwide, mortality rates are highest in New Zealand, Australia, Norway, Denmark, and South Africa (Table II), among others. ¹⁰⁻¹⁶ Mortality rates are uniformly higher in males than females. Rates are rising worldwide, most precipitously in older men, with women of the same age experiencing smaller increases. Mortality rates are decreasing or stabilizing for younger women, and rates among younger men vary by country. For example, mortality has leveled off in Sweden since the mid-1980s, and in particular

Table I. States with top ten highest rates of mortality related to melanoma (all races)*

State	Annual death rate	Dermatologist/ capita rank	Population rank
New Hampshire	3.9 (2.9, 5.2)	22	41
Oklahoma	3.5 (2.9, 4.1)	45	27
Maine	3.5 (2.6, 4.6)	47	40
Utah	3.4 (2.6, 4.4)	16	34
Idaho	3.4 (2.4, 4.6)	29	39
Oregon	3.3 (2.7, 3.9)	10	28
Vermont	3.3 (2.1, 5.1)	30	49
Wyoming	3.2 (1.8, 5.3)	48	51
Kentucky	3.1 (2.6, 3.7)	27	25
Nebraska	3.1 (2.3, 4.0)	38	38

Death data provided by the National Vital Statistics System public use data file. Death rates calculated by the National Cancer Institute using SEER*Stat. Death rates are age-adjusted to the 2000 United States standard population by 5-year age groups. Population counts for denominators are based on Census populations as modified by the National Cancer Institute. (Available from: http://statecancerprofiles.cancer.gov)

The number of dermatologists per state was taken from personal correspondence with Barbara Paez, the Member Services Coordinator of the American Academy of Dermatology, on December 6, 2005.

Population data were taken from the 2000 United States Census (www.census.gov).

*States are shown with their ranking of number of dermatologists per capita in the state (including Washington, DC; 1 = the most dermatologists/capita, 51 = the fewest dermatologists/capita) and with their population size rank (1 = most populous, 51 = least populous).

a statistically significant downward trend was observed in females. 16

Survival

Remarkably, 5-year survival rates now exceed 90% in certain countries, including the United States, Australia, and Sweden. The overall 5-year relative survival rate between 1995 and 2001 from nine US Surveillance, Epidemiology, and End Results (SEER) geographic areas was 91.6% (90.3% for white men; 93.5% for white women). In Scotland, survival rates that were as low as 58% in men in 1978 jumped to 80% in 1993 (P < .001). Case-fatality rates, an important indicator for survival, have improved dramatically in South Australia in only 20 years, and the case-fatality rate for the 1994 to 2000 diagnostic period was 0.79 (95% CI 0.63-0.99) when compared with the 1980 to 1986 baseline.¹⁷

However, it appears that many nations have not benefitted from early detection and educational programs. Low rates of 5-year survival have been found among men in Northern Ireland (53.5), Cracow (55.8), the Czech Republic (60.3), and Slovenia (60.6), equaling survival rates in the United States and Australia from more than 40 years ago. Survival

Table II. Mortality rates for melanoma 2002: Top ten in the world (among those with at least 100 deaths)

Country	Adjusted mortality rate, males	Adjusted mortality rate, females
New Zealand	6.1	3.6
Australia	5.1	2.6
Norway	3.8	2.1
Denmark	3.3	2.2
South Africa	3.1	2.4
Sweden	2.9	1.6
Switzerland	2.7	1.6
Kazakhstan	2.7	2.0
Czech Republic	2.6	1.6
United States	2.6	1.3

Data from Ferlay J et al¹⁵ (available from: http://www-dep.iarc.fr/ globocan/downloads.htm).

rates for women generally fared no better in these four countries, and women had surprisingly high rates of truncal melanoma. 10

Economics serves as another measure of the human toll of melanoma. In the United States, the annual direct cost of treating newly diagnosed melanoma in 1997 was estimated to be \$563 million. Stage I and II disease each comprised about 5% of the total cost; stage III and IV disease consumed 34% and 55% of the total cost, respectively. About 90% of the total annual direct cost of treating melanoma in 1997 was attributable to <20% of patients, primarily those with stage III and IV disease. 18

Summary

Incidence and mortality rates rose precipitously throughout most of the developed and industrialized world from the 1960s through the 1990s. While it may take decades for the effect of primary prevention on melanoma incidence to become evident, public health efforts to promote sun protection and tanning bed avoidance must be vigilantly implemented and maintained. Early detection efforts (secondary prevention) may result in reductions in mortality more quickly than sun protection campaigns, and interventions will be most successful if they target those at greatest risk of disease (see the section on early detection below). Web sites for exploring national and international incidence and mortality trends include Globo Can (http://www-dep.iarc.fr/globocan/ downloads.html) and SEER (http://seer.cancer.gov/).

CLINICAL STRATEGIES FOR EARLIER RECOGNITION AND IDENTIFICATION

Recent advances have heightened our understanding of recognition patterns, the descriptive epidemiology of "melanoma histogenetic type

epidemiology," the relationship between moles and melanoma, and risk factors for melanoma.

Recognition patterns

Abbasi et al¹⁹ conducted a Cochrane Library and PubMed search to re-evaluate the so-called ABCD and to assess literature on evolving lesions. Current data did not support the revision in small diameter lesions, but the review led to a new recommendation for the addition of E for "evolving" to the current ABCD mnemonic.²⁰

Many melanomas do not commonly meet the ABCD criteria. For example, early melanoma is frequently <5 mm in diameter, and nodular and desmoplastic melanomas do not commonly meet the A, B, and C criteria. Conversely, many seborrheic keratoses and atypical nevi fulfill most of the ABCD criteria. Testing the practical utility of the ABCD rule in physician practice, Gachon et al²¹ investigated the practice of 135 volunteer dermatologists and recorded the immediate perceptions and intuitive diagnostic opinion about 4036 consecutive nevi and melanoma. They found that dermatologists generally rely more on the overall pattern and "ugly duckling sign" 22 rather than more well-known algorithms such as the ABCD rule. In a multivariate model attempting to predict what "clues" a physician uses for diagnosing melanoma, overall irregularity, the ugly duckling sign, and recent change according to the patient stood out. Further studies are required to see if this recognition process can be used for teaching to the lay public or non-dermatologist physician. Likewise, in dermoscopy (see dermoscopy section), overall pattern recognition has been shown to be more accurate than specific ABCD criteria.²³

Melanoma histogenetic type epidemiology

During the last few decades, the incidence of thick melanoma has remained stable in most of Australia, the United States, and Western Europe, with little progress in detecting "early" nodular melanoma.

In an analysis of more than 35,000 invasive melanomas from the US SEER Registry (1988-1999), nodular melanoma comprised only 9% of all lesions but accounted for nearly 50% of melanomas 2 mm or deeper when melanomas not otherwise specified were excluded. Median thickness of nodular melanoma changed little from 1988 to 1991 (2.14 mm) to 1995 to 1999 (2.16 mm), and nodular melanoma were nearly 4 times thicker than superficial spreading melanoma (SSM; 0.54 mm, median thickness).³ The world's only outlier appears to be in the South Australia population-based registry, where the proportion of nodular melanoma/all invasive melanoma

dropped from 18.5% (1980-1986) to 10.7% (1994-2000). ¹⁷ In Italy, nodular melanoma also comprised a higher percentage of \geq 2 mm lesions than SSM (65% vs 10%). ²⁴ More than 60% of melanomas \geq 3.5 mm accessioned by the Scottish Melanoma Group were nodular disease, with a trend toward older cases in more recent years (>65% of the thickest cases were in individuals \geq 65 years of age). ²⁵

Because thick melanoma is often nodular disease, there is a strong interest in the clinical presentation and biologic factors of this tumor subtype. Few studies have examined differences between early/late nodular melanoma (NM) or nodular/SSM of similar thickness. Among 54 patients in Sweden, NM patients generally reported that their melanoma was a new lesion, while patients with SSM generally reported a previous pigmented lesion at the site of the melanoma. Thin NM appeared to be smaller in diameter than thick NM. 26 Telltale signs of early SSMs do not appear to be uniformly present in NM. NMs were found more often than SSMs to be symmetric (80%), elevated, uniform in color, and nonpigmented (50% were amelanotic [red or pink]), strikingly different from SSMs, which were primarily brown or black.²⁷ Color change among NM was uncommon. Patients with NM were 10 years older, and their tumors were nearly 3 mm thicker. Liu et al²⁸ found that male sex, older age, and fewer melanocytic nevi were associated with rapid tumor growth. Rapidly growing melanomas were frequently symmetric, amelanotic, elevated, had regular borders, and were symptomatic.²⁸

In a recent population-based study in Queensland, for nearly all melanoma cases, the time between recognition of an abnormality and diagnosis of melanoma apparently does not influence the thickness of the lesion, with the exception of NM, for which there was a positive association with melanoma thickness. The thickness of these lesions was nearly 3% greater per month for each extra month between initial physician identification and diagnosis. ²⁹ Likewise, Liu et al²⁸ recently reported that nodular melanoma grows at 4 times the rate of either SSM or lentigo maligna melanoma (LMM), with an increase of nearly half a millimeter per month.

There are important lessons for melanoma discovery. NMs were self-detected more frequently than SSMs, leading authors to speculate that quickly growing tumors are more likely to draw the attention of the patient, while slow-growing types are more likely to go unnoticed.²⁹ Unfortunately, the reduced "patient delay" in this instance is not associated with thin NM. Moreover, the shorter period of evolution of NM appears to limit the opportunity for detection by physicians. Demierre³⁰ commented that the

association of NMs with solar/actinic keratosis reported by Chamberlain et al and other investigators suggested distinct pathways of melanoma susceptibility. Indeed, a proposed dual pathway hypothesis supported by recent genetic data provides a foundation to develop a risk prediction tool for melanoma.³¹

Invasive LMM has also increased in individuals aged 65 and older, and in a study of the Northern California SEER site, LMM comprises 27% of all invasive melanoma in men 65 years and older. Swetter et al³² concluded that health care providers should be particularly vigilant about screening chronically sun-exposed skin in older, fair-complexioned males.

Amelanotic melanoma in itself is often associated with a delay in diagnosis because of a lack of visible pigment and clinical features which may simulate nonmelanoma skin cancer or benign processes, such as dermatofibroma, verruca vulgaris, or pyogenic granuloma. While amelanotic/hypomelanotic melanoma accounts for an estimated 2% to 8% of all melanomas, ^{33,34} it frequently defies early clinical detection, fails to meet the ABCD criteria, and poses a challenge for dermoscopic evaluation, which utilizes color and pigmented structures to differentiate pigmented skin lesions from nonmelanocytic neoplasms. ³⁵

The influence of age on the association between moles and melanoma

Three recent studies have found similar associations between age and the detection of moles and melanoma. In an analysis of the American Academy of Dermatology (AAD) national screening programs (n = 363 confirmed melanomas), the overall yield of melanoma (the number of confirmed diagnoses per number of screenees) was 1.5 per 1000 screenings, compared with a yield of 2.6 per 1000 screenings among men aged ≥ 50 years. More than 4 melanomas per 1000 screenees were found in men aged ≥ 50 years who reported a changing mole.³⁶

Using baseline total body photography and dermoscopy, Banky et al³⁷ followed 309 patients with at least one of the following risk factors for melanoma: personal history of melanoma, family history of melanoma, more than 100 nevi, or more than 4 atypical nevi. In a follow-up of patients (an average of 3 visits spanning 34 months), younger patients (aged <50) developed new moles more so than older patients (aged >50), but were less likely to develop melanoma. The predictive value for a new mole being a melanoma was greater in patients >50 years of age. Among 311 changing nevi, size was by far the most common type of change (67%). Changing nevi were slightly more common than

new nevi (n = 262) and far more common than regressed nevi (n = 86). Eighteen melanomas were detected in 309 patients; of these, 14 were in patients with changing lesions and 4 were in patients with new lesions. Notably, in patients <50 years of age, <1% of all new lesions were melanomas, whereas in patients >50 years of age, 30% were melanoma. 37

While the estimated annual rate of transformation of any single mole into melanoma was very low (about 1 per 200,000), the lifetime risk of a mole on a 20-year-old male transforming into melanoma by age 80 was 1 per 3164, compared with 1 per 10,800 for women. Cutaneous melanomas were associated with precursors at least 50% of the time for patients <30 years of age. In contrast, for patients over the age of 60, the prevalence of melanoma being associated with a precursor nevus was only 20%.³⁸

Risk factors

Whiteman and Green³⁹ developed hypothetical tables for absolute risks for melanoma among white patients, combining information on environmental, phenotypic, and genotypic causal factors. The 10-year risk of cutaneous melanoma appeared to be highest for older persons residing in southern Australia and the southern United States with \geq 21 nevi on their arms.³⁹

Cho et al⁴⁰ examined risk factors for melanoma in 3 large cohorts of men and women in the United States. Among the nearly 180,000 subjects free of cancer followed for up to 14 years, 535 histologicallyproven melanomas were included. Males had a higher risk for head or neck and trunk lesions. Individuals with >10 sunburns had nearly a 7-fold higher risk of upper extremity melanoma compared with those with no burns. The number of moles was most strongly related to melanoma of the trunk; the relative risk of melanoma for subjects having >10 moles was 4.67 compared with having no moles.⁴⁰ Overall, the association between melanoma and gender, number of nevi, and history of sunburn differed significantly by anatomic site, lending support to the divergent pathway hypothesis of melanoma.³¹ Siskind et al⁴¹ sought to determine whether melanomas arising in the head and neck that are not LMM had different phenotypic and environmental associations than those on other sites. Participants with melanomas of the head and neck were significantly older than patients with melanomas of the trunk, and patients with head and neck melanoma also had fewer nevi.

To explore variables associated with either thin, intermediate, or thick melanoma, Negin et al⁴² prospectively evaluated 369 patients regarding their signs and symptoms at the time of their initial visit.

Gender, age, and primary site were not significantly associated with an increasing category of Breslow depth. In a multivariate analysis, the signs and symptoms most strongly associated with an increased category of Breslow depth were bleeding (odds ratio [OR], 7.5), followed by pain (OR, 3.3), lump (OR, 2.2), itching (OR, 1.9), and change in size (OR, 1.7). Change in color and skin breakdown were not independently associated with an increasing category of Breslow depth. In a recent large, population-based Queensland study of 3772 melanomas, the most commonly reported signs and symptoms in patient-detected cases were changes in color, size, and shape, or irritation or itch at the melanoma site. 43 In fact, persistent lesional itching has been suggested as perhaps the earliest symptom of melanoma in a small percentage of cases.44

EARLY IDENTIFICATION, SCREENING, AND EARLY DETECTION

The early identification of melanoma can be potentially enhanced in multiple venues, such as community-wide screenings, dermatology-led mass screenings, non-dermatologist physician or health-care professional surveillance, by skin-self examination (SSE), specialized pigmented lesion clinics, and education targeted to patients and the public at greatest risk of disease.⁴⁵

Community-wide and mass screening

Because of a relatively low prevalence of mortality and the high costs for mounting such a study, no community-based randomized trial has provided definitive information to determine whether screening asymptomatic persons with whole-body exams by physicians reduces mortality from skin cancer. With the absence of any national or international randomized screening trial, there was insufficient evidence for an expert group such as the US Institute of Medicine (IOM) to provide screening recommendations for melanoma. 46

Researchers in Australia (where such a study is more feasible because of higher rates of melanoma) planned and began to implement a randomized trial of population screening. 47-50 While the plan called for eventually randomizing 44 Queensland communities, 18 were initially randomized to intervention (n = 9) and control (n = 9) towns. The trial's three components included: (1) a community education component, which aimed to provide accurate information about melanoma and screening to residents; (2) an education and support component for medical practitioners, which aimed to increase awareness of the program and to improve doctors' skills in screening for and diagnosing melanoma; and (3)

the provision of free skin screening services. 48-50 Uptake of the whole-body skin cancer examination was measured by surveys of residents in intervention and control towns. Baseline rates were similar in intervention and control towns (11.2% and 11.3%); however, rates jumped 2 years later to 34.8% in intervention towns compared to 13.9% in control communities. 49 Screenings were typically performed by general practitioners (GPs) and special screening services. More than 16,000 whole-body examinations in 18 communities had been conducted, with the following confirmed diagnoses: 33 melanomas, 259 basal cell carcinomas, and 97 squamous cell carcinomas, with the probability of detecting any type of skin cancer of 2.4%. The overall specificity of the skin examination for melanoma was 86.1%. Unfortunately, the study was not expanded to the 44 communities and was recently disbanded because of a lack of governmental funding.

Dermatology-led mass screening programs

Mass, population-wide screening programs are now commonplace in many countries, including Australia, Belgium, Denmark, Italy, the Netherlands, Sweden, Switzerland, the United States, and the United Kingdom. ⁵¹⁻⁵⁸ Programs are uniformly promoted by local media in advance of a screening day, week, or month. Evaluations have generally centered on the results of the screening event, and only in Belgium has the widespread effect on the broader community been reported. ⁵⁵

Analysis of the AAD National Skin Cancer Screening Programs (1986-2001) noted that 65% of screenees had at least one risk factor for melanoma, and 33% reported a changing mole. Among all screenees, nearly 80% did not have a regular dermatologist, 78% reported no previous AAD skin cancer screening, 60% had never had their skin checked by any doctor, and 51% reported that they would not have seen a doctor for skin cancer without the free screening. AAD national screening and educational programs have expanded to all 50 states and provided educational messages about sun protection and early detection to millions. Among nearly 250,000 screenees, 363 melanomas were diagnosed; 98% were stage I melanomas.

Sixty-five percent of Belgian dermatologists participated in a nationwide "Melanoma Monday" campaign. Twenty-five melanomas were confirmed in 2767 screenees. ⁵⁵ Follow-up analysis of the national media campaign led to detection of 141 new melanomas, more than doubling the typical monthly rate of new cases. ⁵⁵ Screening programs in Padova, Italy also found high yield (13 melanomas per 2050 screenees) and generally thin melanoma (92%)

 $<1.50\,$ mm). 53 Three melanomas were detected among more than 1000 screenees in four Italian open access clinic sessions. 51

Few programs have used prescreening publicity to reach high-risk persons who have minimal dermatologic care. Swetter et al⁵⁹ found higher rates of confirmed skin cancer when targeting screening to elderly white men with minimal to no previous dermatologic care, and television, radio messages, and personal history of skin cancer were found to be motivating factors for older men in Utah.⁶⁰

From a survey conducted within the first phase of the Queensland randomized screening trial, factors such as history of a clinical skin examination, concern about skin cancer, personal history of skin cancer, and high susceptibility toward skin cancer were important determinants of screening intention. ⁶¹

In a cost-effectiveness model, Losina et al⁶² found that one-time melanoma screening of the general population was cost-effective compared to other cancer screening programs in the United States. Every 2-year screening in siblings of melanoma patients was also cost-effective. In the general population, one-time, every 2-year, and annual screening saved 2.5, 8.8, and 10.2 quality-adjusted life years (QALYs) per 1000 people screened, with incremental cost-effectiveness ratios of \$7300/QALY, \$58,000/ QALY, and \$450,500/QALY. In siblings of melanoma patients (relative risk [RR] = 2.24 compared to the general population), one-time, every 2-year, and annual screening saved 5.7, 19.2, and 22.6 QALYs per 1000 people screened, with incremental costeffectiveness ratios of \$3400/QALY, \$24,500/QALY, and \$196,500/QALY, respectively.⁶²

Specialized pigmented lesion clinics

Mackie et al⁶³ popularized the use of specialized pigmented lesion clinics (PLCs) in Scotland to provide expert and timely referral services for local physicians and patients. Delay in patient diagnosis was reduced in 2001; 67% of patients visited their physician within 3 months of seeing a worrisome pigmented lesion, compared with only 16% in 1986. 63 To date, only one study has compared the diagnostic performance of a PLC with cancer registry data. Among 1741 PLC patients seen in a clinic in Italy, 15 melanomas were later recorded in the local registry. Excisions had been performed for all but two of the cases: a missed in situ lesion and a 0.60mm melanoma. The PLC exam had a sensitivity of 87% and a specificity of 95%, with a rate of 5.1:1 for excision of benign lesions that were considered melanoma.64

Skin self-examinations

Because lesions on the skin are often visible, the patient should notice suspicious changes. In addition, patients have the most opportunities to examine their skin.⁶⁵ Although physicians detect thinner lesions than patients, it is the patient who most often discovers the melanotic lesion, accounting for about half of all melanomas.⁶⁶

Only one study has tested mortality reduction associated with skin self-examinations (SSEs). Berwick et al⁶⁷ conducted a case-control study and found that SSE could potentially reduce mortality related to melanoma by 63%. More recently, SSE was found to be a key predictor for melanoma <1 mm in thickness.⁶⁸

Only a minority of individuals actually practice regular SSEs. In a study conducted among residents 30 years and older in Queensland, only 26% reported performing a full-body SSE in the past 12 months. Among high-risk patients attending a cancer clinic, 27% reported practicing at least one SSE in the past 4 months. Carli found SSE rates of 21% (at least once every 3 months) among more than 800 melanoma patients in Italy.

SSE rates also differ depending on how one defines the skin self-exam. In a random-digit-dial survey of adults in Rhode Island, 58% reported examining their skin. However, when further probed on how often and what parts of the body were examined, only 9% were considered to thoroughly examine their skin.⁷¹ Further describing barriers for SSE, Weinstock et al⁷¹ found that 29% stated that they do not think about it, 22% believed that they had no reason to, and 15% said that there was nothing there before. Arnold et al⁷² found even stronger barriers among a sample of Boston area young adults in whom more than half did not know what to look for or never thought about performing a SSE. 72 In a later survey of 2126 Rhode Island and Massachusetts adults, Weinstock et al⁷³ found that 19% of men and 17% of women performed a comprehensive SSE. Having a partner and using a wall mirror were key predictors for SSE performance. Notably, respondents with less than a high school degree were less than one-third as likely as college-educated respondents to pay close attention to their skin, look at a particular mole, do casual exams, or perform thorough exams.

Other studies have examined barriers and promoters for performance of SSE. A survey of 549 Connecticut residents found that family history of cancer and past physician examination predicted SSE in men, and that previous benign biopsy or an abnormal mole were individual predictors for both men and women.⁷⁴ In a multivariate model designed

to identify predictors of SSE performance, Robinson et al⁷⁵ found modifiable predictors to be attitudes, knowledge, and confidence in performance. These combined with nonmodifiable variables, such as having dermatology visits with skin biopsies, at least one NM skin cancer nonmelanoma skin cancer (NMSC) in the past 3 years, and younger age to account for 61% of the variability in SSE performance.⁷⁵ Of note, patients with >1 atypical nevus (compared with none) were less likely to detect their melanoma and this held constant after adjustment for all other variables. Carli et al⁷⁶ speculated that patients with many moles may find it difficult to spot suspicious lesions amidst other atypical lesions.

Few studies have sought to test the patient's accuracy in performing a SSE. In a study of highrisk patients (many moles, personal or family history of melanoma, and/or multiple dysplastic nevi) who had practiced SSE regularly for at least a year, Muhn et al⁷⁷ tested whether an artificial increase in size of a mole on the back could be detected by participants conducting SSEs. This controlled trial had 3 phases; first, one mole was changed by 2 mm, then one was changed by 4 mm, and finally there was no change. The sensitivities for self-detecting increases of 2 mm and 4 mm were 58% and 75%; however, the specificity (likelihood of detecting no change when no change occurred) was 62%.⁷⁷

At least three studies have attempted to boost performance of the SSE. Weinstock et al⁷⁸ used molemapping imaging, and nearly all participants were satisfied with the training to assist in SSE; almost half began to perform SSE for the first time after use of the program. After receiving images, spouses and friends were also more frequently participating in skin examinations. 78 Phelan et al 79 led a study of patient responses to the use of photo books to augment SSE performance. Patients with skin cancer used them most frequently, followed by patients with many moles. In addition, 34% of patients requested a CD in addition to their photo book. 79 A randomized trial provided the first evidence of efficacy for involving partners (compared with solo learning) of skills training for the SSE.80

Physician offices

Full-body examinations by either dermatologists or nondermatologist physicians have both shown the potential to save lives that otherwise would have been lost to melanoma. Of the five major "early detectable" cancers (melanoma, breast, colorectal, prostate, and cervical), only skin cancer requires an initial visual, nontechnological skill. Dermatologist examination of the skin has been shown to have relatively high sensitivity and specificity. Carli et al⁶⁸

recommended that dermatologists perform a total body skin examination to identify suspect lesions, particularly during consultations for other reasons. However, Fisher et al⁸¹ suggested that the absence of a standard protocol for skin exams made screening a difficult goal to achieve in all dermatology practices. A survey of US dermatologists⁸² finds that only 30% routinely perform a total skin examination on all of their patients.

Few studies have compared differences in tumor thickness between physicians (either dermatologists or nondermatologist physicians) versus self or family detection. A multivariate analysis led by the Italian Multidisciplinary Group on Melanoma found melanoma detection by a dermatologist to be the strongest predictor of melanoma <1 mm (OR, 0.45; 95% confidence interval [CI], 0.28-0.73).⁶⁸ Likewise, a study of Connecticut patients found that initial melanomas discovered by dermatologists were more likely to be detected below 0.75 mm than those found by nondermatologist physicians.⁸¹ Earlier recognition of melanoma by dermatologists may be partly explained by a recent study comparing dermatologist and primary care physician assessment of lesions. Photographs of randomly chosen lesions were used to evaluate the accuracy of melanoma diagnosis and management of pigmented lesions between 101 dermatologists and 115 primary care physicians. Dermatologists outscored primary care physicians in both domains; however, primary care physicians who routinely biopsied lesions outscored counterparts who did not tend to do so.83

Physicians also detect melanoma at earlier stages compared to patients, spouses or family friends. ^{44,66,84} Epstein et al⁸⁴ found differences of nearly 0.7 mm, and Schwartz et al⁴⁴ found physician-detected melanoma (0.40 mm) to be significantly thinner than patient (1.17 mm) or spouse-detected melanoma (1.00 mm).

Because dermatologists have specialized training, their practice setting is the ideal place for screening; however, most Americans will never see a dermatologist without a referral from their primary care physician. Melanoma patients typically have contact with their physicians in the year before diagnosis, suggesting that many lesions may be diagnosed earlier with the assistance of primary care providers (PCPs). 46 In fact, middle-aged and older men make at least 3 to 4 visits per year to a physician or medical care facility. 85 A single survey of patients in waiting rooms found that 82% reported that it would be appropriate for their PCP to conduct regular fullbody skin examinations, and 87% stated that they would like their PCP to perform a full-body skin exam regularly.⁸⁶ Using a computer simulation model to simulate the effects of a hypothetical melanoma screening program, Girgis⁸⁷ suggested that an every 5-year screening by family physicians for men over the age of 50 would be cost-effective.

Much remains unknown about melanoma discovery patterns and the differences between dermatologist and PCP biopsy and referral practices. Chen et al⁸⁸ performed a systematic review of 32 studies of melanoma discovery patterns conducted before 2001 and found numerous information gaps, including lack of consistent sensitivity and specificity data, inadequate sample sizes, and data derived primarily from residents rather than attending physicians.

Populations at high risk

Before launching an effective educational or early detection program, it is necessary to identify patients at moderate-to-high risk for developing melanoma. Selective education and screening could be considered for individuals with the following high-risk characteristics: middle-aged and older men, family members of melanoma patients, personal history of melanoma, nonmelanoma skin cancer patients, transplant patients, low socioeconomic status (SES), many moles/atypical moles, fair skin, and blue/green eyes, blonde/red hair.

Middle-aged and older men. It is well documented that men, particularly those aged 50 years or older, have higher incidence and mortality rates for melanoma. Of particular relevance to mortality rates, during the past decade, the US incidence of thick tumors (>4 mm) increased significantly only in men aged 60 years and older. 89 For this demographic, the IOM report noted that evidence does support benefits of early melanoma detection and treatment as part of usual medical care and that clinicians and patients should continue to be alert to the common signs of skin cancer, with a particular emphasis on older white males and on melanoma. 46 A crucial step in reducing melanoma mortality is first discovering, then improving the sources that influence awareness of early detection among this high-risk group. Special efforts to reach men aged 50 years and up led to increased screening as part of the Queensland community-based trial. Men at the age of 50 or older comprised 21% of all participants but accounted for 49% of all melanoma diagnoses. 90 Likewise, persons of varying educational levels increased screening rates, likely resulting from well-designed promotional materials.91

Family members of melanoma patients. A randomized trial testing an intervention that provided personalized telephone counseling and individually tailored materials for siblings of recently-diagnosed melanoma patients resulted in greater performance

of SSE (OR, 1.81; 95% CI, 1.04-3.71) at 12 months for intervention siblings compared with controls (receiving standard dermatologist education). The number of participants in both groups that received a skin cancer examination more than doubled, with no differences between intervention and control subjects. 92 Earlier surveys on beliefs and practices regarding skin cancer prevention and detection among 404 siblings of recently diagnosed patients with melanoma found that only 27% had received a skin cancer examination by a dermatologist during the past year; 47% had never received a dermatologic examination. Multivariate analysis found modifiable positive predictors for SSE and dermatologist examinations, including having a clinician with whom to talk about melanoma and believing in the importance of regular skin examinations by a physician. 93 Manne et al 94 found similar skin cancer risk reduction practices of 229 first-degree relatives (FDRs) of recently diagnosed melanoma patients. Forty-five percent of FDRs had received a physician recommendation to perform SSE but only 24% were ever instructed on how to perform the exam.

Personal history of melanoma. It is well documented that personal history of melanoma is one of the strongest risk factors for melanoma. Risk of multiple primary melanoma was recently examined among 4484 patients with primary melanoma (followup of 7 years). Nearly 9% had a second primary melanoma diagnosis; 21% of these patients had a family history of melanoma compared with 12% of patients with a single primary melanoma. DN was twice as common (38% v. 18%) in multiple primary melanoma patients. 95 In a study of melanoma patients at the John Wayne Cancer Institute who received routine education on the performance of the SSE and clinical warning signs, tumor thickness decreased from a mean of 1.32 for the initial melanoma to 0.63 mm for the second primary melanoma.⁹⁶

Non-melanoma skin cancer patients and actinic keratoses. Numerous studies have found that individuals who have a history of either basal cell carcinoma or squamous cell carcinoma are at significantly increased risk of developing a subsequent primary melanoma as compared to the general population. Although the studies vary with regard to the level of risk (ranges from 2.5 to 10.0), all report that NMSC is a significant risk factor for melanoma. 97-106 In a retrospective observational study from the 1992-1998 Medicare Current Beneficiary Study, the OR of developing NMSC or melanoma was increased more than sixfold in patients with actinic keratoses. 107

Transplant patients. Kasiske et al¹⁰⁸ examined rates of malignancies among first-time recipients of

deceased or living donor kidney transplantations in 1995-2001 (n = 35,765) using Medicare billing claims. Compared with patients on the waiting list, several tumors were more common after transplantation including: NMSCs (2.6-fold), melanoma (2.2-fold), Kaposi's sarcoma (9.0-fold), non-Hodgkin's lymphoma (3.3-fold), cancer of the mouth (2.2-fold), and cancer of the kidney (39% higher). ¹⁰⁸ An analysis (1988-1998) of the US Renal Data System (89,786 patients) found 246 melanomas in kidney transplant patients, or a 3.6 fold difference when compared with the general population. 109

Persons of low socioeconomic status/poor **health access.** While it is well known that persons with higher education or income are more likely to be diagnosed with melanoma, less is known about the disproportionate burden of mortality for low SES individuals or for minority populations. Latest examination of the US SEER registry found that overall five-year survival was demonstrably less for minorities (72%-81%) than for whites (89.6%). 110

Reyes-Ortiz¹¹¹ summarized the studies related to the effect of SES on melanoma stage at diagnosis. Of the 12 studies analyzed (8 population-based), all found increased rates of advanced stage melanoma or decreased survival in lower SES individuals. Various indices of social class were used including occupation, education, social class areas, physician supply, and poverty rates. SEER data from records (1988-99) of more than 23,000 melanoma patients were reviewed to assess 5-year melanoma survival. Older patients living in lower SES areas had worse melanoma survival than those from high SES areas. 112

Thicker melanomas (>1.5 mm) were also three times more common in patients with low levels of education or unemployment in Italy. 113 In a study of incident cases of melanoma, colorectal cancer, breast cancer, and prostate cancers diagnosed in Florida, patients who were uninsured were most likely to be diagnosed with a later stage cancer. In fact, lack of insurance was more commonly associated with laterstage melanoma than for other cancers. 114 A merge of Florida state tumor registry data with state physician manpower data revealed that each additional dermatologist per 10,000 residents was associated with a 39% increased likelihood of earlier diagnosis. Roetzheim et al¹¹⁵ suggested that AAD screenings branch out to areas with the shortest supply of dermatologists. In a US National Health Interview Study, having health insurance and a usual source of health care were important predictors for skin cancer screening with few differences between men and women. 116 A UK study found reluctance to seek advice for a suspect lesion was most pronounced

among persons from socially deprived districts, suggesting that there could be significant attitudinal barriers to screening among certain groups. 117

A Behavioral Risk Factor Surveillance Study in Massachusetts conducted in 2002 found the lack of education to be the strongest predictor for unawareness of melanoma as being a cancer of the skin. Only 59% of persons with less than a high school degree correctly defined melanoman compared to more than 90% for people with a college degree. 118

Many moles/atypical moles. Oliveria et al conducted a randomized trial of patients with five or more dysplastic nevi; half of patients received a teaching intervention (physician and nurse education module) with a photo book (personal wholebody photographs compiled in the form of a booklet, with nurse instruction on how to use the photographs), and the remainder received only the teaching intervention. Four months later, 61% patients in the photo book intervention reported skin examination three or more times (P = .039) for paired comparison) compared with 37% in the group receiving the teaching intervention alone. 119

NEW TECHNOLOGIES: DERMOSCOPY AND PHOTOGRAPHY

We highlight the dermoscopy studies from metaanalyses, randomized trials, links with other outcome data (eg, cancer registries), and comparisons with naked-eye examinations.

Annual total cutaneous examination, total cutaneous photography, and dermoscopy were employed for patients with classic atypical mole syndrome (CAMS) and a heterogeneous group of patients at high risk (ie, those with high-risk non-CAMS [HRNCAMS]). A total of 258 patients (160 CAMS and 98 HRNCAMS) were studied. In the CAMS cohort, 28 new MMs developed in 19 patients resulting in a cumulative 10-year risk of 14% (95% CI; 7-20). In the HRNCAMS cohort, 10 new MMs developed in 9 patients, and the cumulative 10-year risk was 10% (95% confidence interval: 2-17). The MMs diagnosed in both cohorts were either in situ or <1 mm in Breslow thickness. 120

Carli et al¹²¹ has conducted the only randomized trial to test differences in the management of equivocal lesions between the naked-eye examination, naked-eye examination plus dermoscopy (with mandatory excisions), and the possibility of digital follow-up according to the clinician's decision. Patients in the combined arm had significantly fewer lesions referred for surgery. However, the authors expressed concern that the digital follow-up of equivocal lesions was associated with a small occurrence of initial melanomas left unexcised.

Meta-analysis of all studies performed before 2001 found that dermoscopy, when performed by trained examiners, had greater discriminating power for melanoma than clinical examination alone. Bafounta et al¹²² called for improved technology to reduce the proportion of false-negative findings. Kittler¹²³ conducted a meta-analysis of 27 studies that compared the accuracy of melanoma diagnosis with and without dermoscopy. Dermoscopy yielded an improvement of 49% compared to naked eye exams; however, dermoscopy by untrained or less experienced examiners showed no improvements compared with the clinical examination.

Four algorithms (the Menzies method, the 7-point checklist, the ABCD rule, and pattern analysis) were tested for diagnostic accuracy by 61 "nonexpert" physicians in Australia (35 GPs). More than half of the physicians diagnosed 5 or fewer melanomas annually. Clinical and dermoscopic image assessment of 40 melanocytic skin lesions revealed high rates of diagnostic accuracy (73-81%) following selfguided training with all four algorithms. However, the Menzies method showed the highest diagnostic accuracy and sensitivity, and was most widely well-accepted by study participants. ¹²⁴

In a study of 100 pigmented lesions for which no agreement was reached, Carli et al¹²⁵ found that an examination of lesions based on morphologic features (including dermoscopy), without any contact with the patient, was associated with the risk of incorrect classification in as many as 60% of early melanomas, and as many as 30% of lesions were left unexcised. The authors asserted that for equivocal, hard-to-diagnose lesions, physicians should be aware of potential risks associated with teleconsultation or with automated melanoma derived from using only digital instruments.

Massone et al¹²⁶ noted that the accuracy of traditional clinical diagnosis of melanoma ranges between 65% and 80%, and concluded that the naked-eye examination with the ABCD system may fail to detect the so-called "small melanoma" as well as melanomas regular in shape or color. Recognition and prompt removal of lesions that are clinically or dermoscopically suspicious for melanoma should be the main aim of dermoscopy, as well as avoiding unnecessary excision of benign lesions. Important moves toward standardizing the dermoscopic diagnosis have been made via the development of the Consensus Net Meeting on Dermoscopy (CNMD). Forty trained dermoscopists from many countries evaluated 108 lesions via the Internet using a 2-step process that discriminated between melanocytic and nonmelanocytic lesions. The most specific dermoscopic criteria for early melanoma detection were

asymmetry, atypical pigment network, and blue—white structures. These criteria achieved a sensitivity approaching 97%. 127

Feit et al 128 also found that follow-up photography added to the detection of evolving, thin melanoma. Among all new melanomas, change in baseline photos resulted in detection of 74% melanomas; 19% were new lesions. Many of the changing lesions did not correspond with the clinical criteria for melanoma but were most evident with careful review of baseline and follow-up photographs. Lucas et al¹²⁹ found that lesions categorized as both nonuniform and changed (by dermoscopy) were more than four times as likely to be melanoma compared with other categories: uniform and changed, nonuniform and unchanged and uniform and unchanged. Of the 16 melanomas found in the study, none developed from an obvious dysplastic nevus, 5 evolved from lesions that appeared to be small nevi, 4 evolved in an area where a small pinpoint focus of pigment could be identified, and 7 evolved in skin with no previous identifiable lesion. 129

Oliveria et al¹³⁰ reviewed the emerging technologies and examined the many factors needed for more broad-scale implementation including physician training, low-cost equipment, and research into patient, physician, and health care system uptake of new technologies.

PROFESSIONAL AND PUBLIC EDUCATION

We describe the prevalence of screening by physicians, medical students, and nurses, and report on most recent professional training programs.

Skin cancer screening rates

While skin screening by PCPs may be an effective tool in reducing advanced stage melanoma, in practice, the rates of screening (whether reported by the public or professionals) are low. In a random survey of the US adult population in 1998, only 21% had ever had a full head-to-toe skin examination. 131 Reports from 784 primary care visits to 109 family practitioners and 61 internists as part of the 1997 National Ambulatory Care Survey revealed that skin examinations were reported at only 16% of visits, much lower than reported rates for other cancer screenings. 132 In a survey of patients in dermatology and primary care clinic waiting rooms at a Veterans Affairs medical center, 32% reported undergoing regular full body skin examinations by their PCP.82 This rate did not differ between respondents in the primary care or in the dermatology clinic.

Physicians report higher rates of screening than the public. Altman et al¹³³ surveyed almost 1400

PCPs throughout the United States regarding their cancer screening practices. Approximately 37% of physicians reported screening most of their patients for skin cancer. 133 A more recent survey of family medicine physicians, internists, and GPs sought to determine the national rates of melanoma screening. Sixty percent of eligible physicians responded, and of these, nearly 60% physicians routinely performed full-body examinations with their high-risk patients. In the regression analysis of factors influencing physician examination of high-risk patients, lack of time was the strongest barrier [odds ratio (OR) 0.3 (95% confidence interval (CI) 0.2 to 0.6)]. Physicians using the most information sources [OR 2.5 (95% CI 1.3 to 4.8)] were the most likely to examine their high-risk patients. Physicians whose patients requested a skin examination were more likely to examine their patients compared with physicians whose patients did not request such an examination $(P < .01).^{134}$

While screening by PCPs has the potential of being an effective screening tool, physicians and medical students have noted various barriers to doing skin screenings. Physicians and medical students have noted a lack of time, skill, and confidence as barriers to skin examinations. ^{135,136} In a survey of nearly 500 PCPs, Kirsner et al ¹³⁵ noted that 50% felt that their lack of confidence in screening for skin cancer was an important obstacle.

Physician interventions

Forty-one family physicians in Tuscany received a 4-hour training session on the diagnosis, management, and decision plans for dermatology referrals. Training led to a marked increase in melanoma diagnosis (using slides) with a concomitant improvement in specificity (55-73%) for a dermatology referral. 137 Harris et al 138 demonstrated increased confidence in identifying suspicious lesions through the use on an Internet Continuing Medical Education program to 354 US physicians. Satisfaction among physician users was nearly 90%. In a controlled study of an Internet-based skin cancer triage intervention for physicians, Gerbert et al¹³⁹ found intervention effects for physician skin cancer diagnosis and evaluation planning. Although the study was limited by questions asked immediately after a lecture, a study of Belgian GPs found improvements in the proportion of pigmented lesions correctly identified. 140 A 2-hour Basic Skin Cancer Triage (BSCT) curriculum was designed to improve the skills, knowledge, confidence, and attitudes of 28 PCPs in Rhode Island. Significant changes from pretest to posttest were made in provider ability to accurately diagnose and triage lesions, provide reassurance about

lesions, and improve knowledge of skin cancer control practices. ¹⁴¹ Successful utilization of the BSCT curriculum in broader settings awaits further study. An educational video shown to randomly selected family physicians did not result in significant differences in the proportion of malignant lesions biopsied. ¹⁴²

Medical school training

In a 2004 study of more than 650 fourth-year students at seven US medical schools, Moore et al¹⁴³ found that 43% had never performed a skin cancer screening exam. However, students performing at least one examination were nearly 3 times more likely to report being moderately skilled in the skin cancer exam. Brandling-Bennett et al¹⁴⁴ conducted focus groups with New England medical students to discover optimal venues within the medical school curriculum to insert skin cancer education. Lee et al¹³⁶ reported that third year medical students at UCLA felt least competent in performing skin cancer examinations compared to clinical breast, Pap smear, and digital rectal exams.

Nurses

A 1997 survey of 457 Texas nurses found that 61% believed that skin cancer detection was part of their practice; more than 60%, however, noted that lack of national guidelines and low priority of skin screening by doctors served as key barriers. ¹⁴⁵ Using the consensus clinical diagnosis of the dermatologists as the gold standard, the nurse practitioner's sensitivity for detecting significant skin cancer lesions ranged from 50% to 100% and the detection specificity was 99% to 100%. ¹⁴⁶

Public and patient education

In the past 5 years, numerous organizations and foundations have launched melanoma Web sites replete with photographs of normal and abnormal lesions and techniques to perform SSE. 147-149 One study found that the majority of Web sites failed to include complete information on general information, risk factors, diagnosis, treatment, prevention, and prognosis. Medical information retrieved with the search term melanoma was likely to lack complete basic melanoma information and contained inaccuracies in 14% of sites. 150 Bichakjian et al 150 noted that health care providers can help patients by recommending comprehensive and accurate Web sites, by working to create accurate and thorough Web-based health information material, and by educating patients and the public about the variability in completeness and accuracy. Bhavnani¹⁵¹ investigated the way that facts on melanoma were distributed across high-quality Web pages using inter-rater experiments with skin cancer physicians. In-person training of the public and teaching about the ABCD criteria resulted in better assessments of common moles and dysplastic nevi (DN). Branstrom et al¹⁵² conducted a study of 120 Swedish residents (30 each with pigmented lesions, DNs, melanoma, and from a healthy population) and found reasonably good ability to identify malignant changes but less ability to recognize common moles and DN.

Two randomized trials have tested different methods of patient education. One found that knowledge of melanoma improved with the use of a videotape compared with a clinic visit; however, physician encounters were more effective in reducing patient anxiety or distress. ¹⁵³ A second study used different methods to engage patients in recognition of early melanoma and found photographs to be far superior to use of only the ABCD rule. ¹⁵⁴

CONCLUSIONS

With the recent, abrupt cessation of the population-based, randomized screening trial in Queensland, randomized studies of large cohorts with many years of follow-up, as required to rigorously demonstrate that early detection of melanoma is desirable, may never be funded. Thus, there is the possibility that we will never have the evidence required to conclude that screening effectively reduces melanoma mortality.

Disturbingly low screening rates in the presence of persistent and avoidable mortality prompt a call for new and far-reaching approaches, including ways to make screening more available to underserved individuals, targeted education to the highrisk public, and "early" professional education to health professional students in all disciplines. 155 In Australia, where early detection (or screening) campaigns were initiated earlier than in Europe, a shift toward thinner lesions, more SSM melanomas, and fewer NMs has been observed over time, and has been accompanied by improvements in melanoma survival. In most industrialized nations, much progress has been made in detecting earlier lesions, reducing case-fatality, and improving survival. Dramatic progress at the population level, as evident in Australia, hopefully foreshadows subsequent efforts in the United States and elsewhere.

We are left with a number of questions derived from the summary review above: (1) Can new technologies and advances in vigilant surveillance of persons with key risk factors for melanoma be extended more broadly to persons with less access to expert dermatologic care? (2) Can we deepen our understanding of the biologic, clinical, and behavioral antecedents of NM that now comprises a disproportionate burden of late-stage melanoma? (3) Can the widespread proliferation of Internet information for physicians and the public alike be harnessed to identify early curable melanoma among our most at-risk Americans? (4) Can randomized trials testing some or all of the strategies described earlier-public education, physician screening, and skin self-examination be conducted to gather most relevant information for planning large-scale programs?

REFERENCES

- American Cancer Society. Cancer facts and figures 2007. Available at: www.cancer.org/downloads/STT/CAFF2007PW Secured.pdf. Accessed June 13, 2007.
- Ries LAG, Eisner MP, Kosary CL, et al. SEER Cancer Statistics Review, 1975-2002. Bethesda MD: National Cancer Institute; http://seer.cancer.gov/csr/1975_2002/.
- Demierre MF, Chung C, Miller DR, Geller AC. Early detection of thick melanomas in the United States: beware of the nodular subtype. Arch Dermatol 2005;141:745-50.
- Welch HG, Woloshin S, Schwartz LM. Skin biopsy rates and incidence of melanoma: population-based ecological study. BMJ 2005;331:3.
- Marrett LD, Nguyen HL, Armstrong BK. Trends in the incidence of cutaneous malignant melanoma in New South Wales, 1983-1996. Int J Cancer 2001;92:457-62.
- Lindholm C, Andersson R, Dufmats M, Hansson J, Ingvar C, Moller T, et al, for the Swedish Melanoma Study Group. Invasive cutaneous malignant melanoma in Sweden, 1990-1999. A prospective, population-based study of survival and prognostic factors. Cancer 2004;101:2067-78.
- MacKie RM, Bray CA, Hole DJ, Morris A, Nicolson M, Evans A, et al, from the Scottish Melanoma Group. Incidence of and survival from malignant melanoma in Scotland: an epidemiological study. Lancet 2002;360:587-91.
- de Vries E, Bray FI, Eggermont AM, Coebergh JW, for the European Network of Cancer Registries. Monitoring stagespecific trends in melanoma incidence across Europe reveals the need for more complete information on diagnostic characteristics. Eur J Cancer Prev 2004;13:387-95.
- de Vries E, Bray FI, Coebergh JW, Parkin DM. Changing epidemiology of malignant cutaneous melanoma in Europe 1953-1997: rising trends in incidence and mortality but recent stabilizations in western Europe and decreases in Scandinavia. Int J Cancer 2003;107:119-26.
- 10. de Vries E, Coebergh JW. Cutaneous malignant melanoma in Europe. Eur J Cancer 2004;40:2355-66.
- Crocetti E, Capocaccia R, Casella C, Guzzinati S, Ferretti S, Rosso S, et al. Population-based incidence and mortality cancer trends (1986-1997) from the network of Italian cancer registries. Eur J Cancer Prev 2004;13:287-95.
- 12. Diepgen TL, Mahler V. The epidemiology of skin cancer. Br J Dermatol 2002;61:1-6.
- Stang A, Jockel KH. Changing patterns of skin melanoma mortality in West Germany from 1968 through 1999. Ann Epidemiol 2003;13:436-42.
- 14. Severi G, Giles GG, Robertson C, Boyle P, Autier P. Mortality from cutaneous melanoma: evidence for contrasting trends between populations. Br J Cancer 2000;82:1887-91.
- Ferlay J, Bray F, Pisani P, Parkin DM. GLOBOCAN 2002. Cancer incidence, mortality and prevalence worldwide. IARC Cancer-Base No. 5, version 2.0. Lyon, France: IARCPress; 2004.

- Cohn-Cedermark G, Mansson-Brahme E, Rutqvist LE, Larsson O, Johansson H, Ringborg U. Trends in mortality from malignant melanoma in Sweden, 1970-1996. Cancer 2000;89:348-55.
- Luke CG, Coventry BJ, Foster-Smith EJ, Roder DM. A critical analysis of reasons for improved survival from invasive cutaneous melanoma. Cancer Causes Control 2003;14:871-8.
- Tsao H, Rogers GS, Sober AJ. An estimate of the annual direct cost of treating cutaneous melanoma. J Am Acad Dermatol 1998;38(5 Pt 1):669-80.
- Abbasi NR, Shaw HM, Rigel DS, Friedman RJ, McCarthy WH, Osman I, et al. Early diagnosis of cutaneous melanoma; revisiting the ABCD criteria. JAMA 2004;292:2771-6.
- Rigel DS, Friedman RJ, Kopf AW, Polsky D. ABCDE—an evolving concept in the early detection of melanoma. Arch Dermatol 2005;141:1032-4.
- Gachon J, Beaulieu P, Sei JF, Gouvernet J, Claudel JP, Lemaitre M, Richard MA, et al. First prospective study of the recognition process of melanoma in dermatological practice. Arch Dermatol 2005;141:434-8.
- 22. Grob JJ, Bonerandi JJ. The 'ugly duckling' sign. Arch Derm 1998;134:103-4.
- Carli P, Quercioli E, Sestini S, Stante M, Ricci L, Brunasso G, et al. Pattern analysis, not simplified algorithms, is the most reliable method for teaching dermsocopy for melanoma diagnosis to residents in dermatology. Br J Dermatol 2003;148:981-4.
- 24. Carli P, De Giorgi V, Palli D, Maurichi A, Mulas P, Orlandi C, et al. Patterns of detection of superficial spreading and nodular-type melanoma: a multicenter Italian study. Dermatol Surg 2004;30:1371-5.
- 25. Murray CS, Stockton DL, Doherty VR. Thick melanoma: the challenge persists. Br J Dermatol 2005;152:104-9.
- Bergenmar M, Hansson J, Brandberg Y. Detection of nodular and superficial spreading melanoma with tumor thickness
 2.0 mm-an interview study. Eur J Cancer Prev 2002;11:49-55.
- Chamberlain AJ, Fritschi L, Kelly JW. Nodular melanoma: patients' perceptions of presenting features and implications for earlier detection. J Am Acad Dermatol 2003;48:694-701.
- Liu W, Dowling JP, Murray WK, McArthur GA, Thompson JF, Wolfe R, et al. Rate of growth in melanomas: characteristics and associations of rapidly growing melanomas. Arch Dermatol 2006;142:1551-8.
- Baade PD, English DR, Youl PH, McPherson M, Elwood JM, Aitken JF. The relationship between melanoma thickness and time to diagnosis in a large population-based study. Arch Dermatol 2006;142:1422-7.
- Demierre MF. Thin melanomas and regression, thick melanomas and older men: prognostic implications and perspectives on secondary prevention. Arch Dermatol 2002;138:678-82.
- Whiteman DC, Watt P, Purdie DM, Hughes MC, Hayward NK, Green AC. Melanocytic nevi, solar keratoses, and divergent pathways to cutaneous melanoma. J Natl Cancer Inst 2003; 95:806-12.
- Swetter SM, Boldrick JC, Suny SY, Egbert BM, Harvell JD. Increasing incidence of lentigo maligna melanoma subtypes: northern California and national trends 1990-2000. J Invest Dermatol 2005;125:303-10.
- 33. Bono A, Maurich A, Moglia D, Camerini T, Tragni G, Lualdi M, et al. Clinical and dermoscopic diagnosis of early amelanotic melanoma. Melanoma Res 2001;11:491-4.
- Pizzichetta MA, Talamini R, Staganelli I, Puddu P, Bono R, Argenziano G, et al. Amelanotic/hypomelanotic melanoma: clinical and dermoscopic features. Br J Dermatol 2004;150: 1117-24.
- de Giorgi V, Sestini S, Massi D, Maio V, Giannotti B. Dermoscopy for 'true' amelanotic melanoma: A clinical

- dermoscopic-pathologic case study. J Am Acad Dermatol 2006;54:341-4.
- 36. Geller AC, Sober AJ, Zhang Z, Brooks DR, Miller DR, Halpern A, et al. Strategies for improving melanoma education and screening for men age ≥ 50 years: findings from the American Academy of Dermatological National Skin Cancer Screening Program. Cancer 2002;95:1554-61.
- Banky JP, Kelly JW, English DR, Yeatman JM, Dowling JP. Incidence of new and changed nevi and melanomas detected using baseline images and dermoscopy in patients at high risk for melanoma. Arch Dermatol 2005;141:998-1006.
- Tsao H, Bevona C, Goggins W, Quinn T. The transformation rate of moles (melanocytic nevi) into cutaneous melanoma: a population-based estimate. Arch Dermatol 2003;139:282-8.
- Whiteman DC, Green AC. A risk prediction tool for melanoma? Cancer Epidemiol Biomarkers Prev 2005;14:761-3.
- Cho E, Rosner BA, Colditz GA. Risk factors for melanoma by body site. Cancer Epidemiol Biomarkers Prev 2005;14:1214-4.
- 41. Siskind V, Whiteman DC, Aitken JF, Martin NG, Green AC. An analysis of risk factors for cutaneous melanoma by anatomical site (Australia). Cancer Causes Control 2005;16:193-9.
- Negin BP, Riedel E, Oliveria SA, Berwick M, Coit DG, Brady MS. Symptoms and signs of primary melanoma: important indicators of Breslow depth. Cancer 2003;98:344-8.
- McPherson M, Elwood M, English D, Baade PD, Youl PH, Aitken JF. Presentation and detection of invasive melanoma in a highrisk population. J Am Acad Dermatol 2006;54:783-92.
- Schwartz JL, Wang TS, Hamilton TA, Lowe L, Sondak VK, Johnson TM. Thin primary melanomas: associated detection patterns, lesion characteristics, and patient characteristics. Cancer 2002;95:1562-8.
- 45. Geller AC. Screening for melanoma. Dermatol Clin 2002;20: 629-40.
- Institute of Medicine. Extending Medicare coverage for prevention and other services. Washington, DC: National Academy Press; 2000.
- Aitken JF, Elwood JM, Lowe JB, Firman DW, Balanda KP, Ring IT. A randomised trial of population screening for melanoma. J Med Screen 2002;9:33-7.
- Lowe JB, Ball J, Lynch BM, Baldwin L, Janda M, Stanton WR, et al. Acceptability and feasibility of a community-based screening programme for melanoma in Australia. Health Promot Int 2004;19:437-44.
- Aitken JF, Janda M, Elwood M, Youl PH, Ring IT, Lowe JB. Clinical outcomes from skin screening clinics within a community-based melanoma screening program. J Am Acad Dermatol 2006;54:105-14.
- Aitken JF, Youl PH, Janda M, Lowe JB, Ring IT, Elwood M. Increase in skin cancer screening during a community-based randomized intervention trial. Int J Cancer 2006;118:1010-6.
- 51. Carli P, De Giorgi V, Giannotti B, Seidenari S, Pellacani G, Peris K, et al. Skin cancer day in Italy: method of referral to open access clinics and tumor prevalence in the examined population. Eur J Dermatol 2003;13:76-9.
- Geller AC, Zhang Z, Sober AJ, Halpern AC, Weinstock MA, Daniels S, et al. The first 15 years of the American Academy of Dermatology skin cancer screening programs: 1985-1999.
 J Am Acad Dermatol 2003;48:34-41.
- Rossi CR, Vecchiato A, Bezze G, Mastrangelo G, Montesco MC, Mocellin S, et al. Early detection of melanoma: an educational campaign in Padova, Italy. Melanoma Res 2000;10:181-7.
- Tyler I, Rivers JK, Shoveller JA, Blum A. Melanoma detection in British Columbia, Canada. J Am Acad Dermatol 2005;52:48-54.
- 55. Vandaele MM, Richert B, Van der Endt JD, Boyden B, Brochez L, del Marmol V, et al. Melanoma screening: results of the first

- one-day campaign in Belgium ('melanoma Monday'). J Eur Acad Dermatol Venereol 2000;14:470-2.
- Nikkels AF, Nikkels-Tassoudji N, Jerusalem-Noury E, Sandman-Lobusch H, Sproten G, Zeimers G, et al. Skin cancer screening campaign in the German speaking community of Belgium. Acta Clinica Belgica 2004;59:194-8.
- 57. Bulliard JL, Levi F, Panizzon RG. The 2003 "Solmobile" prevention campaign for skin cancers of the Swiss League against Cancer: results and stakes [in French]. Revue Medicale de la Suisse Romande 2004;124:237-40.
- Holme SA, Varma S, Chowdhury MM, Roberts DL. Audit of a melanoma screening day in the U.K.: clinical results, participant satisfaction and perceived value. Br J Dermatol 2001; 145:784-8.
- Swetter SM, Waddell BL, Vazquez MD, Khosravi VS. Increased effectiveness of targeted skin cancer screening in the Veterans Affairs population of Northern California. Prev Med 2003; 36:164-71.
- 60. Call TR, Boucher KM, Whiting BL, Hart M, Newman K, Kinney AY, et al. Motivating factors for attendance of skin cancer screenings. J Am Acad Dermatol 2004;51:642-4.
- Janda M, Youl PH, Lowe JB, Elwood M, Ring IT, Aitken JF. Attitudes and intentions in relation to skin checks for early signs of skin cancer. Prev Med 2004;39:11-8.
- 62. Losina E, Walensky RP, Geller AC, Beddingfield FC, Wolf LL, Gilchrest BA, et al. Visual screening for malignant melanoma: a cost-effectiveness analysis. Arch Dermatol 2007;143:21-8.
- Mackie RM. Effect of public education aimed at early diagnosis of malignant melanoma: cohort comparison study. BMJ 2003:326:367.
- Carli P, Nardini P, Crocetti E, De Giorgi V, Giannotti B. Frequency and characteristics of melanomas missed at a pigmented lesion clinic: a registry-based study. Melanoma Res 2004;14:403-7.
- 65. Weinstock MA. Early detection of melanoma. JAMA 2000; 284:886-9.
- Brady MS, Oliveria SA, Christos PJ, Berwick M, Coit DG, Katz J, et al. Patterns of detection in patients with cutaneous melanoma. Cancer 2000;89:342-7.
- 67. Berwick M, Begg CB, Fine JA, Roush GC, Barnhill RL. Screening for cutaneous melanoma by skin self-examination. J Natl Cancer Inst 1996;88:17-23.
- 68. Carli P, De Giorgi V, Palli D, Maurichi A, Mulas P, Orlandi C, et al. Dermatologist detection and skin self-examination are associated with thinner melanomas: results from a survey of the Italian Multidisciplinary Group on Melanoma. Arch Dermatol 2003;139:607-12.
- Aitken JF, Janda M, Lowe JB, Elwood M, Ring IT, Youl PH, et al. Prevalence of whole-body skin self-examination in a population at high risk for skin cancer (Australia). Cancer Causes Control 2004;15:453-63.
- Phelan DL, Oliveria SA, Christos PJ, Dusza SW, Halpern AC. Skin self-examination in patients at high risk for melanoma: a pilot study. Oncol Nurs Forum 2003;30:1029-36.
- Weinstock MA, Martin RA, Risica PM, Berwick M, Lasater R, Rakowski W, et al. Thorough skin examination for the early detection of melanoma. Am J Prev Med 1999;17:169-75.
- Arnold MR, DeJong W. Skin self-examination practices in a convenience sample of US university students. Prev Med 2005;40:268-73.
- Weinstock MA, Risica PM, Martin RA, Rakowski W, Smith KJ, Berwick M, et al. Reliability of assessment and circumstances of performance of thorough skin self-examination for the early detection of melanoma in the Check-it-Out Project. Prev Med 2004;38:761-5.

- Oliveria SA, Christos PJ, Halpern AC, Fine JA, Barnhill RL, Berwick M. Evaluation of factors associated with skin selfexamination. Cancer Epidemiol Biomarkers Prev 1999;8:971-8.
- 75. Robinson JK, Fisher SG, Turrisi RJ. Predictors of skin self-examination performance. Cancer 2002;95:135-46.
- Carli P, De Giorgi V, Palli D, Maurichi A, Mulas P, Orlandi C, et al. Self-detected cutaneous melanomas in Italian patients. Clin Exp Dermatol 2004;29:593-6.
- Muhn CY, From L, Glied M. Detection of artificial changes in mole size by skin self-examination. J Am Acad Dermatol 2000;42:754-9.
- 78. Weinstock MA, Nguyen FQ, Martin RA. Enhancing skin selfexamination with imaging: evaluation of a mole-mapping program. J Cutan Med Surg 2004;8:1-5.
- Phelan DL, Oliveria SA, Halpern AC. Patient experiences with photo books in monthly skin self-examinations. Dermatol Nurs 2005:17:109-14.
- Robinson JK, Turrisi R, Stapleton J. Examination of mediating variables in a partner assistance intervention designed to increase performance of skin self-examination. J Am Acad Dermatol 2007;56:391-7.
- Fisher NM, Schaffer JV, Berwick M, Bolognia JL. Breslow depth of cutaneous melanoma: impact of factors related to surveillance of the skin, including prior skin biopsies and family history of melanoma. J Am Acad Dermatol 2005;53: 303-406
- Federman DG. Kraveta, Kirsner RS. Skin cancer screening by dermatologists: prevalence and barriers. J Am Acad Dermatol 2002;46:710-4.
- 83. Chen SC, Pennie ML, Kolm P, Warshaw EM, Weisberg EL, Brown KM, et al. Diagnosing and managing cutaneous pigmented lesions: primary care physicians versus dermatologists. J Gen Intern Med 2006;21:678-82.
- 84. Epstein DS, Lange JR, Gruber SB, Mofid M, Koch SE. Is physician detection associated with thinner melanomas? JAMA 1999;281:640-3.
- National Center for Health Statistics. Health, United States, 2005. With chartbook on trends in the health of Americans. Hyattsville, MD: National Center for Health Statistics; 2005.
- 86. Federman DG, Kravetz JD, Tobin DG, Ma F, Kirsner RS. Full-body skin examinations: the patient's perspective. Arch Dermatol 2004;140:530-4.
- Girgis A, Clarke P, Burton RC, Sanson-Fisher RW. Screening for melanoma by primary health care physicians: a cost-effectiveness analysis. J Med Screen 1996;3:47-53.
- 88. Chen S, Bravata DM, Weil E, Olkin I. A comparison of dermatologists' and primary care physicians' accuracy in diagnosing melanoma. Arch Dermatol 2001;137:1627-34.
- Jemal A, Devesa SS, Fears TR, Hartge P. Cancer surveillance series: changing patterns of cutaneous malignant melanoma mortality rates among whites in the United States. J Natl Cancer Inst 2000;92:811-8.
- 90. Janda M, Youl PH, Lowe JB, Baade PD, Elwood M, Ring IT, et al. What motivates men ages > or = 50 years participate in a screening program for melanoma? Cancer 2006;107:815-23.
- 91. Youl PH, Janda M, Elwood M, Lowe JB, Ring IT, Aitken JF. Who attends skin cancer clinics within a randomized melanoma screening program? Cancer Detect Prev 2006;30:44-51.
- Geller AC, Emmons KM, Brooks DR, et al. A randomized trial to improve early detection and prevention practices among siblings of melanoma patients. Cancer 2006;107:806-14.
- Geller AC, Emmons K, Brooks DR, Zhang Z, Powers C, Koh HK, et al. Skin cancer prevention and detection practices among siblings of patients with melanoma. J Am Acad Dermatol 2003:49:631-8.

- Manne S, Fasanella N, Connors J, Floyd B, Wang H, Lessin S. Sun protection and skin surveillance practices among relatives of patients with malignant melanoma: prevalence and predictors. Prev Med 2004;39:36-47.
- Ferrone CR, Ben Porat L, Panageas KS, Berwick M, Halpern AC, Patel A, et al. Clinicopathological features of and risk factors for multiple primary melanomas. JAMA 2005;294:1647-54.
- Difronzo LA, Wanek LA, Morton DL. Earlier diagnosis of second primary melanoma confirms the benefit of patient education and routine postoperative follow-up. Cancer 2001;91:1520-4.
- Bower CP, Lear JT, Bygrave S, Etherington D, Harvey I, Archer CB. Basal cell carcinoma and risk of subsequent malignancies: a cancer registry-based study in southwest England. J Am Acad Dermatol 2000;42:988-91.
- Friedman GD, Tekawa IS. Association of basal cell skin cancers with other cancers (United States). Cancer Causes Control 2000;11:891-7.
- 99. Hemminki K, Dong C. Subsequent cancers after in situ and invasive squamous cell carcinoma of the skin. Arch Dermatol 2000;136:647-51.
- Levi F, La Vecchia C, Te VC, Randimbison L, Erler G. Incidence of invasive cancers following basal cell skin cancer. Am J Epidemiol 1998;147:722-6.
- 101. Maitra SK, Gallo H, Rowland-Payne C, Robinson D, Moller H. Second primary cancers in patients with squamous cell carcinoma of the skin. Br J Cancer 2005;92:570-1.
- 102. Milán T, Pukkala E, Verkasalo PK, Kaprio J, Jansén CT, Koskenvuo M, et al. Subsequent primary cancers after basal-cell carcinoma: A nationwide study in Finland from 1953 to 1995. Int J Cancer 2000:87:283-8.
- Nugent Z, Demers AA, Wiseman MC, Mihalcioiu C, Kliewer EV. Risk of second primary cancer and death following a diagnosis of nonmelanoma skin cancer. Cancer Epidemiol Biomarkers Prev 2005;14:2584-90.
- Rosenberg CA, Greenland P, Khandekar J, Loar A, Ascensao J, Lopez AM. Association of nonmelanoma skin cancer with second malignancy. Cancer 2004;100:130-8.
- 105. Strayer SM. Does having basal cell carcinoma increase a person's risk of melanoma? Health News 2003;9:12.
- Troyanova P, Danon S, Ivanova T. Nonmelanoma skin cancers and risk of subsequent malignancies: a cancer registry-based study in Bulgaria. Neoplasma 2002;49:81-5.
- 107. Chen GJ, Feldman SR, Williford PM, Hester EJ, Kiang SH, Gill I, et al. Clinical diagnosis of actinic keratosis identifies an elderly population at high risk of developing skin cancer. Dermatol Surg 2005;31:43-7.
- 108. Kasiske BL, Danpanich E. Malignancies in renal transplant recipients. Transplant Proc 2000;32:1499-500.
- 109. Hollenbeak CS, Todd MM, Billingsley EM, Harper G, Dyer AM, Lengerich EJ. Increased incidence of melanoma in renal transplantation recipients. Cancer 2005;104:1962-7.
- 110. Cormier JN, Xing Y, Ding M, Lee JE, Mansfield PF, Gershenwald JE, et al. Ethnic differences among patients with cutaneous melanoma. Arch Intern Med 2006;166:1907-14.
- Reyes-Ortiz CA, Goodwin JS, Freeman JL. The effect of socioeconomic factors on incidence, stage at diagnosis and survival of cutaneous melanoma. Med Sci Monitor 2005; 11:RA163-72.
- Reyes-Ortiz CA, Goodwin JS, Freeman JL, Kuo YF. Socioeconomic status and survival in older patients with melanoma. J Am Geriatr Soc 2006;54:1758-64.
- 113. Montella M, Crispo A, Grimaldi M, De Marco MR, Ascierto PA, Parasole R, et al. An assessment of factors related to tumor thickness and delay in diagnosis of melanoma in southern Italy. Prev Med 2002;35:271-7.

- 114. Roetzheim RG, Pal N, Tennant C, Voti L, Ayanian JZ, Schwabe A, et al. Effects of health insurance and race on early detection of cancer. J Natl Cancer Inst 1999;91:1409-15.
- 115. Roetzheim RG, Pal N, van Durme DJ, Wathington D, Ferrante JM, Gonzalez EC, et al. Increasing supplies of dermatologists and family physicians are associated with earlier stage of melanoma detection. J Am Acad Dermatol 2000;43(2 Pt 1): 211-8
- Saraiya M, Hall HI, Thompson T, Hartman A, Glanz K, Rimer B, et al. Skin cancer screening among U.S. adults from 1992, 1998, and 2000 National Health Interview Surveys. Prev Med 2004;39:308-14.
- Eiser JR, Pendry L, Greaves CJ, Melia J, Harland C, Moss S. Is targeted early detection for melanoma feasible? Self assessments of risk and attitudes to screening. Journal of Medical Screening 2000;7:199-202.
- 118. Commonwealth of Massachusetts Department of Public Health. Massachusetts Behavioral Risk Factor Survey, 2002. Available at: http://www.mass.gov/dph//bhsre/cdsp/brfss/brfss.htm. Accessed August 7, 2007.
- Oliveria SA, Dusza SW, Phelan DL, Ostroff JS, Berwick M, Halpern AC. Patient adherence to skin self-examination. Effect of nurse intervention with photographs. Am J Prev Med 2004;26:152-5.
- 120. Wang SQ, Kopf AW, Koenig K, Polsky D, Nudel K, Bart RS. Detection of melanomas in patients followed up with total cutaneous examinations, total cutaneous photography, and dermoscopy. J Am Acad Dermatol 2004;50:15-20.
- 121. Carli P, de Giorgi V, Chiarugi A, Nardini P, Weinstock MA, Crocetti E, et al. Addition of dermoscopy to conventional naked-eye examination in melanoma screening: a randomized study. J Am Acad Dermatol 2004;50:683-9.
- 122. Bafounta ML, Beauchet A, Aegerter P, Saiag P. Is dermoscopy (epiluminescence microscopy) useful for the diagnosis of melanoma? Results of a meta-analysis using techniques adapted to the evaluation of diagnostic tests. Arch Dermatol 2001;137:1343-50.
- 123. Kittler H, Pehamberger H, Wolff K, Binder M. Diagnostic accuracy of dermosocpy. Lancet Oncol 2002;3:159-65.
- 124. Doliantis C, Kelly J, Wolfe R, Simpson R. Comparative performance of 4 dermoscopic algorithms by nonexperts for the diagnosis of melanocytic lesions. Arch Dermatol 2005;141: 1008-14.
- 125. Carli P, Chiarugi A, De Giorgi V. Examination of lesions (including dermoscopy) without contact with the patient is associated with improper management in about 30% of equivocal melanomas. Dermatol Surg 2005;31:169-72.
- 126. Massone C, Di Stefani A, Soyer HP. Dermoscopy for skin cancer detection. Curr Opin Oncol 2005;17:147-53.
- 127. Argenziano G, Soyer HP, Chimenti S, Talamini R, Corona R, Sera F, et al. Dermoscopy of pigmented lesions: results of a consensus meeting via the Internet. J Am Acad Dermatol 2003;48:679-93.
- 128. Feit NE, Dusza SW, Marghoob AA. Melanomas detected with the aid of total cutaneous photography. Br J Dermatol 2004;150:706-14.
- 129. Lucas CR, Sanders LL, Murray JC, Myers SA, Hall RP, Grichnik JM. Early melanoma detection: nonuniform dermascopic features and growth. J Am Acad Dermatol 2003;48:663-71.
- Oliveria SA, Sachs D, Belasco KT, Halpern AC. Adoption of new technologies for early detection of melanoma in dermatologic practice. J Am Acad Dermatol 2003;49:955-9.
- 131. Santmyire BR, Feldman SR, Fleischer AB Jr. Lifestyle high-risk behaviors and demographics may predict the level of participation in sun-protection behaviors and skin cancer

- primary prevention in the United States: results of the 1998 National Health Interview Survey. Cancer 2001;92:1315-24.
- Oliveria SA, Christos PJ, Marghoob AA, Halpern AC. Skin cancer screening and prevention in the primary care setting: national ambulatory medical care survey 1997. J Gen Intern Med 2001;16:297-301.
- Altman JF, Oliveria SA, Christos PJ, Halpern AC. A survey of skin cancer screening in the primary care setting: a comparison with other cancer screenings. Arch Fam Med 2000;9:1022-7.
- 134. Geller AC, O'Riordan DL, Oliveria SA, Valvo S, Teich M, Halpern AC. Overcoming obstacles to skin cancer examinations and prevention counseling for high-risk patients: results of a national survey of primary care physicians. J Am Board Fam Pract 2004;17:416-23.
- Kirsner RS, Muhkerjee S, Federman DG. Skin cancer screening in primary care: prevalence and barriers. J Am Acad Dermatol 1999:41:564-6.
- Lee M, Hodgson CS, Wilkerson L. Predictors of self-perceived competency in cancer screening examinations. J Cancer Educ 2002;17:180-2.
- Carli P, De Giorgi V, Crocetti E, Caldini L, Ressel C, Giannotti B. Diagnostic and referral accuracy of family doctors in melanoma screening: effect of a short formal training. Eur J Cancer Prev 2005;14:51-5.
- Harris JM, Salasche SJ, Harris RB. Can Internet-based continuing medical education improve physicians' skin cancer knowledge and skills? J Gen Intern Med 2001;16:50-6.
- 139. Gerbert B, Bronstone A, Maurer T, Berger T, McPhee SJ, Caspers N, et al. The effectivenss of an internet-based tutorial in improving primary care physicians skin cancer triage skills. J Cancer Educ 2002;17:7-11.
- 140. Brochez L, Verhaeghe E, Bleyen L, Naeyaert JM. Diagnostic ability of general practitioners and dermatologists in discriminating pigmented skin lesions. J Am Acad Dermatol 2001;44:979-86.
- 141. Mikkilineni R, Weinstock MA, Goldstein MG, Dube CE, Rossi JS. The impact of the basic skin cancer triage curriculum on providers' skills, confidence, and knowledge in skin cancer control. Prev Med 2002;34:144-52.
- 142. de Gannes GC, Ip JL, Martinka M, Crawford RI, Rivers JK. Early detection of skin cancer by family physicians: a pilot project. J Cutan Med Surg 2004;8:103-9.

- 143. Moore MM, Geller AC, Zhang Z, Hayes BB, Bergstrom K, Graves JE, et al. Skin cancer examination teaching in US medical education. Arch Dermatol 2006;142:439-44.
- 144. Brandling-Bennett H, Capaldi L, Gilchrest BA, Geller AC. Improving skin cancer prevention and detection education in U.S. medical schools. Arch Dermatol 2006;142:524-6.
- 145. Christos PJ, Oliveria SA, Masse LC, McCormick LK, Halpern AC. Skin cancer prevention and detection by nurses: attitudes, perceptions, and barriers. J Cancer Educ 2004;19:50-7.
- 146. Oliveria SA, Nehal KS, Christos PJ, Sharma N, Tromberg JS, Halpern AC, et al. Using nurse practitioners for skin cancer screening: a pilot study. Am J Prev Med 2001;21:214-7.
- 147. Skin Cancer Foundation Web site. Available at: http://www.skincancer.org/. Accessed June 1, 2007.
- 148. American Cancer Society Web site. Available at: http://www.cancer.org/docroot/home/index.asp. Accessed June 1, 2007.
- 149. American Academy of Dermatology Web site. Available at: http://www.aad.org/default.htm. Accessed June 1, 2007.
- Bichakjian CK, Schwartz JL, Wang TS, Hall JM, Johnson TM, Biermann JS. Melanoma information on the Internet: often incomplete—a public health opportunity? J Clin Oncol 2002;20:134-41.
- Bhavani SK. The distribution of online health care information. A case study on melanoma. AMIA 2003 Symposium Proceedings, 81-85.
- Branstrom R, Hedblad MA, Krakau I, Ullén H. Laypersons' perceptual discrimination of pigmented skin lesions. J Am Acad Dermatol 2002;46:667-73.
- 153. Orringer JS, Fendrick AM, Trask PC, Bischakjian CK, Schwartz JL, Wang TS, et al. The effects of a professionally produced videotape on education and anxiety/distress levels for patients with newly diagnosed melanoma: a randomized, prospective clinical trial. J Am Acad Dermatol 2005;53:224-9.
- 154. Girardi S, Gaudy C, Gouvernet J, et al. Superiority of a cognitive education with photographs over ABCD criteria in the education of the general population to the early detection of melanoma: a randomized study. Int J Cancer 2006;118:2276-80.
- 155. Geller AC, Swetter SM, Miller DR, Demierre MF, Gilchrest BA. A call for the development and implementation of a targeted melanoma screening program. Arch Dermatol 2006; 142:504-7.