

Incidence Estimate of Nonmelanoma Skin Cancer in the United States, 2006

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Objectives: To estimate the incidence of nonmelanoma skin cancer (NMSC) in the US population in 2006 and secondarily to indicate trends in numbers of procedures for skin cancer treatment.

Design: A descriptive analysis of population-based claims and US Census Bureau data combined with a population-based cross-sectional survey using multiple US government data sets, including the Centers for Medicare and Medicaid Services Fee-for-Service Physicians Claims databases, to calculate totals of skin cancer procedures performed for Medicare beneficiaries in 1992 and from 1996 to 2006 and related parameters. The National Ambulatory Medical Care Service database was used to estimate NMSC-related office visits. We combined these to estimate totals of new skin cancer diagnoses and affected individuals in the overall US population.

Results: The total number of procedures for skin cancer in the Medicare fee-for-service population increased by 76.9% from 1 158 298 in 1992 to 2 048 517 in 2006. The age-adjusted procedure rate per year per 100 000 beneficiaries increased from 3514 in 1992 to 6075 in 2006.

From 2002 to 2006 (the years for which the databases allow procedure linkage to patient demographics and diagnoses), the number of procedures for NMSC in the Medicare population increased by 16.0%. In this period, the number of procedures per affected patient increased by 1.5%, and the number of persons with at least 1 procedure increased by 14.3%. We estimate the total number of NMSCs in the US population in 2006 at 3 507 693 and the total number of persons in the United States treated for NMSC at 2 152 500.

Conclusions: The number of skin cancers in Medicare beneficiaries increased dramatically over the years 1992 to 2006, due mainly to an increase in the number of affected individuals. Using nationally representative databases, we provide evidence of much higher overall totals of skin cancer diagnoses and patients in the US population than previous estimates. These data give the most complete evaluation to date of the underrecognized epidemic of skin cancer in the United States.

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NONMELANOMA SKIN CANCER (NMSC) is the most common malignancy in the United States, with substantial associated morbidity and cost, as well as relatively smaller but significant mortality. The most recent, peer-reviewed, published, national incidence estimate is from 1994. This study estimated 900 000 to 1 200 000 NMSCs in that year, approximately equaling all other cases of human malignancies combined.^{1,2} However, the exact incidence of NMSC is unknown because the condition is not typically reported to cancer registries.

Several studies have documented trends in skin cancer incidence in the US population.³⁻¹⁰ A study of 3 counties in New Mexico described increases in age-

adjusted NMSC rates from 71.8 per 100 000 persons in 1972 to 150.4 per 100 000 persons in 1999, a 109% increase.⁶ Evaluation of the Southeastern Arizona Skin Cancer Registry demonstrated a leveling off of NMSC incidence with a decrease in squamous cell carcinoma (SCC) rates.¹⁰ Another study of age-adjusted rates for NMSC in New Hampshire showed a 235% increase in females and a 350% increase in males for SCC, and an 80% increase in basal cell carcinoma (BCC) incidence from 1979 to 1993.⁴ Increases in skin cancer incidence have also been documented in multiple areas outside the United States.¹¹⁻¹⁵

Understanding skin cancer incidence and treatment is important for planning prevention strategies and allocating resources for treatment. Medicare claims data

from 1992 to 1995 showed that the cost per affected patient per year of NMSC was only 5% to 10% that of many other cancers.¹⁶ For example, in 1992, the costs per affected patient of stomach, lung, breast, melanoma, and NMSC were \$9010, \$5609, \$1718, \$1130, and \$431, respectively. However, the large number of cases made NMSC the fifth most costly cancer to treat overall in the Medicare population, with NMSC accounting for over 4.5% of all Medicare cancer costs and over 0.7% of the Medicare budget for physician services.^{16,17} Furthermore, these costs increased 41% between 1992 and 1995.¹⁶ The primary purpose of this study is to estimate 2006 NMSC incidence in the United States using national population-based data sources.

METHODS

DATA SOURCES

Our analyses were based primarily on 2 distinct Medicare databases and on national survey data. The Medicare physician/supplier procedure summary master file (hereinafter, Total Claims Data Set) was analyzed for the years 1992 and 1996 to 2006 (available years).¹⁸ For our primary approach to the estimation of NMSC, the 2006 Total Claims Data Set was used to provide total numbers of approved fee-for-service Medicare claims categorized by Current Procedural Terminology (CPT) procedure code number.¹⁹ However, the Total Claims Data Set does not contain information relating to patient age or *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* diagnosis, associated with each procedure code.²⁰ The Medicare Limited Data Set Standard Analytic File 5% Sample Physician Supplier Data (hereinafter, 5% Sample Data Set) was available for 2002 to 2006.²¹ This nationally sampled Medicare database contains information on claims filed for approved procedures with their associated *ICD-9-CM* diagnosis codes, patient age stratification, and counts of unique persons receiving the services. Hence, the 5% Sample Data Set allowed estimation of the proportion of procedures for skin cancer that were for NMSC, the proportion of procedures that were conducted on enrollees older than 65 years, and the mean number of procedures per enrollee with any procedures.

The National Ambulatory Medical Care Survey (NAMCS) is a cross-sectional survey system of ambulatory-based physicians wherein participating physicians complete a questionnaire for patient visits during a random 1-week period of the year.²² These visit observations are then used to provide a national estimate of physician visits and limited characteristics of these visits for that year. The NAMCS allowed estimation of the proportion of visits for NMSC in the United States that were conducted in the population older than 65 years.

ESTIMATION OF THE TOTAL NUMBER OF NMSCs IN 2006

For this study, we define NMSC incidence in 2 ways: as newly diagnosed NMSCs and as persons with a newly diagnosed NMSC, with the latter as our primary definition, although we present both. The number of skin cancers in the fee-for-service Medicare population was estimated in this study as the total of approved skin cancer treatment procedures (malignant destructions, malignant excisions, and Mohs micrographic surgical procedures) for that year from the Total Claims Data Set. Thus, the crude number of skin cancers for a given year was estimated by adding the numbers of approved

claims for skin cancer procedure code series (11600-11606, 11620-11626, and 11640-11646 for malignant excisions; 17260-17266, 17270-17276, and 17280-17286 for malignant destructions, 17304 for Mohs surgical procedures). The total specific to NMSC was determined by multiplying the estimated crude number of skin cancers by the proportion of skin cancer procedure code claims associated with the *ICD-9-CM* diagnoses for invasive nonmelanoma cutaneous malignancy (173.0-173.9) and in situ malignancy (232.0-232.9) from the 5% Sample Data Set. The number of procedures per affected individual and the number of unique persons that underwent at least 1 procedure were also derived from the 5% Sample Data Set.

Based on our *ICD-9-CM* code definition of NMSC, almost all of the skin cancers measured in this study were keratinocyte carcinomas (ie, BCC, invasive SCC, or SCC in situ). However, other varieties of skin cancer are also included in our totals, such as Merkel cell carcinoma, adnexal carcinomas, and malignant melanoma in situ. These cancers are relatively uncommon compared with BCC and SCC, and because of the imprecise nature of *ICD-9-CM* coding, we cannot separate procedures for these diagnoses. Excluded from our count were some forms of NMSC, such as cutaneous lymphoma and genital skin cancers that have separate *ICD-9-CM* codes. Therefore, although some malignant melanomas in situ are included in our estimates, and some NMSCs are excluded, the overall number of keratinocyte carcinomas is so much larger that these inclusions and exclusions should have a small effect on our overall estimate. For example, analysis of the Surveillance, Epidemiology, and End Results (SEER) database for 2006 estimates 49 710 new US cases of malignant melanoma in situ (1.4% of our total NMSC estimate).²³ For this article, we will use the common but admittedly imprecise term NMSC.

The number of NMSCs in the Medicare population 65 years or older was established from the Total Claims Data Set and the 5% Sample Data Set. The proportion of the entire US population (≥ 65 years) covered under Medicare was derived from the Center for Medicare and Medicaid Services 2007 Trustee's report and US census data, allowing estimation of the number of NMSCs in the entire population segment that was 65 years or older.^{24,25} The proportion of total office visits for NMSC *ICD-9-CM* codes (173.0-173.9 and 232.0-232.9) that were for the segment of the population that was 65 years or older in 2006 was obtained from the NAMCS. The number of NMSCs in the US population (≥ 65 years old) was then divided by the proportion of office visits for NMSC in that group, allowing estimation of the total number of skin procedures for NMSC in the United States. The total number of persons in the United States diagnosed as having NMSC in that year was calculated from the skin cancer procedure totals and the number of NMSCs per affected Medicare patient. More detailed representation of the calculation described in this section is available at the Skin Cancer Center Web site.²⁶

AGE ADJUSTMENT OF NMSC RATES

The age-adjusted NMSC Medicare Part B Fee-for-Service procedure rate was calculated, standardized to the year 2006. The Total Claims Data Set for 1992 and 1996 to 2006 does not contain age-stratified data. Therefore, crude skin cancer procedure rates were derived using this database, but age-specific rates could not be determined. The 5% Sample Data Set is age stratified in 5-year intervals and allowed calculation of age-adjusted procedure rates. The methods and calculations deriving age-adjusted procedure rates are available at the Skin Cancer Center Web site.²⁷

Table 1. Number of Procedures and of Age-Adjusted Procedures for All Skin Cancers in the Medicare Fee-for-Service Population

Year	Total Skin Cancer Procedures	Age-Adjusted Procedure Rate per 100 000 Beneficiaries	Procedures to Treat NMSC, %
1992	1 158 298	3514	NA
1996	1 377 741	4136	NA
1997	1 450 746	4400	NA
1998	1 473 728	4521	NA
1999	1 497 444	4647	NA
2000	1 577 165	4947	NA
2001	1 694 913	5173	NA
2002	1 785 136	5312	92.6
2003	1 834 443	5322	93.8
2004	1 905 121	5477	92.7
2005	2 007 826	5772	92.4
2006	2 048 517	6075	93.7

Abbreviations: NA, not available; NMSC, nonmelanoma skin cancer.

RESULTS

The total number of fee-for-service Medicare skin cancer procedures increased over the 15 years of the study (1992, 1996-2006) from 1 158 298 to 2 048 517, with an overall increase of 77.0% (**Table 1**). The age-adjusted rate of skin cancer procedures increased from 3514 per 100 000 beneficiaries in 1992 to 6075 in 2006 (Table 1). Using the diagnosis-specific 5% Sample Data Set, the overall NMSC-specific procedure rate increased by 16.0% from 2002 to 2006, whereas the average number of procedures per beneficiary increased by 1.5% from 1.61 to 1.63 (**Table 2**). Extending this analysis, the number of persons with at least 1 procedure for NMSC increased by 14.3% from 2002 to 2006.

Using the Total Claims Data Set and 5% Sample Data Set, the following calculations were performed. In 2006, 93.7% or 1 919 460 of the approved procedures were specific for NMSC. The 2006 total NMSC procedures for fee-for-service Medicare patients 65 years or older, as a proportion of such procedures for fee-for-service Medicare patients at all ages, were 83.5% (or 1 604 477 procedures). The percentage of the US population 65 years or older enrolled in fee-for-service Medicare was 73.8%. Thus, the number of procedures for NMSC in 2006 in the United States in persons 65 years or older can be estimated at 2 174 383. The NAMCS estimates of office visits for NMSC diagnoses in the US population in 2006 are 4 003 887, of which 2 482 801 (62.0%) were ascribed to patients 65 years or older. Combining the Total Claims Data Set, 5% Sample Data Set, and NAMCS, we estimate the total number of NMSCs treated in the United States in 2006 at 3 507 693. From the 5% Sample Data Set, the ratio of skin cancers treated per affected patient in 2006 is 1.63. If this ratio is extended to the US population, then the number of persons in the United States who were treated for NMSC in 2006 can be estimated at 2 152 500.

Table 2. Nonmelanoma Skin Cancer (NMSC) Specific Statistics for the Medicare Fee-for-Service Population

Year	No.		
	Total NMSC Procedures	Services per Affected Person	Affected Persons
2002	1 653 260	1.61	1 030 220
2003	1 720 560	1.61	1 067 620
2004	1 765 900	1.61	1 098 700
2005	1 854 480	1.62	1 147 600
2006	1 918 340	1.63	1 177 400

COMMENT

Nonmelanoma skin cancer is the most common malignancy in the United States and is not reported in most registries; hence, the exact incidence is unknown. Based on the limited studies available, skin cancer rates seem to be climbing rapidly in the US population. The data presented herein from national databases indicate that the incidence of skin cancer in the United States has substantially increased from 1992 through 2006 and is now about double the last published estimate from 1994.¹

In evaluating increases in the US incidence of NMSC since 1994, we considered the relatively direct estimate described in the "Methods" section, and the alternative of estimating change in incidence over the 12-year period and applying that proportion increase to the published 1994 data. We elected the former because the published 1994 incidence was itself a projection from a variety of sources and subject to considerable error. Estimation of trends from published data was limited by the very small number of published reports. Estimation by regression modeling of NAMCS data was ultimately rejected because the small sampling frame and year-to-year variation in visit frequency limited the reliability of our conclusions.

This study's strengths are that it is current and based on Medicare and NAMCS nationally representative data sets. In particular, the Medicare data incorporate a huge sample size of all covered individuals and provide strong estimative power.

There are some important limitations in this study's estimates of NMSC incidence. This study assumes that 1 NMSC treatment procedure equals 1 incident NMSC. Given that a physician should not bill for a skin cancer procedure without first obtaining a pathologic diagnosis of skin cancer, the number of skin cancer procedures is a reasonable proxy for the number of skin cancers. On the one hand, retreatment of a skin cancer owing to positive histologic margins or recurrence would result in overestimation in this model. On the other hand, biopsies that remove an entire lesion would not be captured by the procedure codes we used, which would result in underestimation. Reimbursement denial of a skin cancer claim by Medicare or treatment of a cancer by a nonsurgical modality (such as radiation or topical chemotherapy) would also result in underestimation. Another limitation of this study is that in calculating the total number

of NMSCs and the numbers of affected persons, multiple other assumptions are required. The calculations assume that the portion of the US population that is older than 65 years and not covered under Medicare fee-for-service has the same rate of skin cancer as the portion that is covered under Medicare; that the ratio of office visits for a diagnosis of NMSC to the number of procedures for NMSC as defined by the NAMCS is approximately the same in those 65 years or older or younger than 65 years; and that the rate of NMSCs per affected individual is the same in the US population as a whole as for the Medicare fee-for-service population.

We found little similar literature published in the past 15 years. The most recent peer-reviewed estimate of NMSC incidence was from 1994.¹ That study was a projection to 1994 from population-based estimates of NMSC from the 1970s, based on trends from studies of distinct regions of North America. The estimate of 900 000 to 1.2 million new cases of NMSC in the United States in 1994 has been carried forward to the present day and is cited by the American Cancer Society and National Cancer Institute, despite the presumed increases in incidence since that time.^{2,28} Although the present report has substantial limitations, it provides a much stronger NMSC estimate than has previously been published. Nevertheless, this effort underscores the need for a system of sentinel registries for NMSC to allow for better monitoring of our efforts to combat the most common cancer in the United States.

Having accurate estimates of NMSC incidence is important in establishing the public health burden of this condition. However, other components beyond total numbers must be considered. Mortality from NMSC is low but not zero. Morbidity and decreased quality of life are magnified and take on increased importance in common conditions that underscore the importance of better defining and decreasing morbidity due to NMSC. Last, the dollar cost of NMSC treatment is also still poorly defined.²⁹ However, further study on the cost of skin cancer treatment should allow better estimation of the costs to the health care system.³⁰

There is an epidemic of NMSC in the United States, as illustrated by comparison with the previously published estimates and the 4.2% yearly average increase in cases in the Medicare population from 1992 to 2006. To date, educational programs emphasizing sun protection have mainly been disappointing in slowing skin cancer rates.³¹ In the face of ongoing increases in skin cancer incidence, continued national research and programs on treatment, education, and prevention are critical.

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