

## Skin Cancer in U.S. Elderly Adults: Does Life Expectancy Play a Role in Treatment Decisions?

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**OBJECTIVES:** To examine whether life expectancy influences treatment pattern of nonmelanoma skin cancer, or keratinocyte carcinoma (KC), the most common malignancy and the fifth most costly cancer to Medicare.

**DESIGN:** Nationally representative cross-sectional study.

**SETTING:** Nationally representative Health and Retirement Study linked to Medicare claims.

**PARTICIPANTS:** Treatments (N = 9,653) from individuals aged 65 and older treated for basal or squamous cell carcinoma between 1992 and 2012 (N = 2,702) were included.

**MEASUREMENTS:** Limited life expectancy defined according to aged 85 and older, medical comorbidities, Charlson Comorbidity Index score of 3 or greater, difficulty in at least one activity of daily living (ADL), and a Lee index of 13 or greater. Treatment type (Mohs micrographic surgery (MMS) (most intensive, highest cost), excision, or electrodesiccation and curettage (ED&C) (least intensive, lowest cost)), according to procedure code.

**RESULTS:** Most KCs (61%) were treated surgically. Rates of MMS (19%), excision (42%), and ED&C (39%) were no different in participants with limited life expectancy and those with normal life expectancy. For example, 19% of participants with difficulty or dependence in ADLs, 20% of those with a Charlson comorbidity score greater than 3, and 15% of those in their last year of life underwent MMS; participants who died within 1 year of diagnosis were treated in the same way as those who lived longer.

**CONCLUSION:** A one-size-fits-all approach in which advanced age, health status, functional status, and prognosis are not associated with intensiveness of treatment appears to guide treatment for KC, a generally nonfatal

condition. Although intensive treatment of skin cancer when it causes symptoms may be indicated regardless of life expectancy, persons with limited life expectancy should be given choices to ensure that the treatment matches their goals and preferences. *J Am Geriatr Soc* 64:1610–1615, 2016.

**Key words:** skin cancer; basal cell carcinoma; squamous cell carcinoma; end of life

**K**eratinocyte carcinoma (KC), including basal cell carcinoma (BCC) and squamous cell carcinoma (SCC), is by far the most common cancer in the United States,<sup>1</sup> with more than 3.5 million new cases treated each year.<sup>2</sup> A range of treatments that vary in invasiveness and cost can be used to treat most KCs effectively. Common treatments include topical chemotherapy creams, tumor destruction with electrodesiccation and curettage (ED&C), and surgery. Surgery for KC can involve simple excision or Mohs micrographic surgery (MMS). The rationale for MMS is that it aims to remove as much of the cancer as possible and prevent tumor recurrence, which for these typically slow-growing tumors occurs several years later (mean 3.3 years).<sup>3</sup> Although randomized trial data are limited, prospective cohort studies suggest that all surgical treatments offer greater than 95% cure rates for primary tumors.<sup>3</sup>

When choosing from among treatments with comparable clinical outcomes, considerations of cost, risks, procedure duration, and preference matter. Mohs micrographic surgery costs approximately twice as much as excision, which is about twice as expensive as ED&C.<sup>4</sup> Mohs micrographic surgery also takes an average of 3 hours (up to 8 hours with repair), compared with an average of 1 hour for surgical excision and 20 minutes for ED&C.<sup>5</sup> Complications and self-reported problems after these treatments are common, especially in elderly adults.<sup>6</sup> Fourteen percent of individuals report medical problems with treatment, including bleeding, pain, and poor wound healing,<sup>6</sup>

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which usually occur within the first year of treatment, whereas the potential benefit of more-intensive treatment in preventing recurrence is several years in the future. This lag-time to benefit is an increasingly important consideration when making healthcare decisions in elderly individuals who may not live long enough to benefit from more-intensive treatments but may be at risk of short-term treatment-related complications.<sup>7,8</sup>

In some cases, KC causes distress because its location causes cosmetic concerns or because it leads to symptoms. In these situations, even in individuals with severe comorbidity, the most-intensive treatment option is clearly appropriate if it is best treats KC-related symptoms, but previous research demonstrates that many skin cancers cause no symptoms and that many are discovered incidentally. For the majority of skin cancer that causes no or minimal symptoms, life expectancy should be a fundamental determinant of procedure choice in older adults with skin cancer for two reasons; individuals with limited life expectancy often prefer more-conservative treatment choices and may not live long enough to benefit from intensive treatments when there is significant lag-time to benefit. Therefore, it would be expected that rates of MMS would be lower at the end of life.

Although KC is the fifth most costly cancer for Medicare (>\$500 million annually),<sup>9,10</sup> only one single-city study has examined how prognostic characteristics of older adults affect treatment selection.<sup>11</sup> The current national study was conducted to examine whether individuals with limited life expectancy were more likely to receive less-invasive treatment. A national representative study linked to Medicare claims that had extensive information on participant characteristics that strongly affect life expectancy was used.

## METHODS

### Population

The Health and Retirement Study (HRS), which the National Institute on Aging sponsors (Grant U01AG009740) and the University of Michigan conducts, is an ongoing nationally representative longitudinal study of the health of community-dwelling individuals aged 50 and older that started in 1992. New participants are recruited to the study every 6 years to keep the study representative of the U.S. population. Interviews are administered over the telephone or in person every 2 years. Proxy respondents are asked to provide the answers for participants with physical or cognitive limitations. The HRS collects information on financial, social, medical, and functional status.

The current study objective was to compare treatment patterns for KC according to individual prognostic characteristics in a nationally representative sample of older adults. More than 80% of HRS participants agree to have their Medicare claims linked to their HRS interviews.<sup>12</sup> Medicare claims data were available for 1992–2008. Because the cancer treatments were ascertained from Medicare claims, the study was focused on participants aged 65 and older who were eligible for Medicare and had

HRS data linked to Medicare claims data. Subjects who had at least 1 year of Medicare claims data before the skin cancer claim were included.

### Skin Cancer Treatment

The primary outcome was skin cancer treatment, defined based on *International Classification of Diseases, Ninth Revision* (ICD-9) and procedure code. Skin cancer diagnosis was defined as ICD-9 codes 232.xx or 173.xx. Three types of treatment were examined: excision, ED&C, and MMS. All procedures were identified in outpatient and carrier files using following Healthcare Common Procedure Coding System procedure codes (excisions: 11600–11606, 11620–11626, 11640–11646, 26117, 11750; ED&C: 17260–17266, 17270–17276, 17280–17286; MMS 17311, 17313, 17304).<sup>13</sup> Although radiation therapy for BCC is becoming more common, this treatment modality was extremely rare during the study period and was not included.

Ten thousand seven hundred thirty-nine Medicare claims that reported at least one potential skin cancer treatment were identified. Claims for which there was no ICD-9 diagnosis of skin cancer in the 90 days before the claim ( $n = 1,893$ , 17%) were excluded from the study. An additional 618 (6%) claims were excluded because there was no corresponding HRS interview within one wave before the claim. The analysis was limited to white participants (excluded  $n = 164$ , 1.5% claims from nonwhite participants). Each participant could have multiple claims (because individuals with skin cancer tend to have multiple tumors), and each claim could have more than one treatment (e.g., two skin cancers removed at the same visit). The final sample included 8,064 Medicare claims for skin cancer treatment, corresponding to 9,653 distinct treatments in 2,702 individuals (Figure 1).

### Prognostic Characteristics

A number of variables for which there is strong evidence of a link to limited life expectancy in older adults were considered:

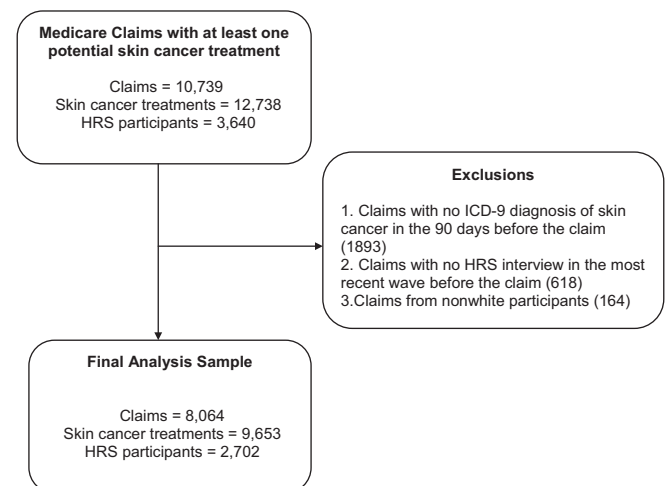


Figure 1. Study flowchart.

- Advanced age ( $\geq 85$ ), which is associated with a life expectancy of 6 years.<sup>14</sup>
- Comorbid disease burden, considering individual diagnoses (self-reported heart disease, stroke, cancer, lung disease, diabetes mellitus, hypertension) and Charlson comorbidity score, an index of disease burden closely linked to survival.<sup>15</sup> Charlson score was derived from Medicare claims data.
- Self-reported independence in activities of daily living (ADLs: ability to bathe, dress, walk across a room, transfer in and out of bed, use the toilet, eat). Subjects were classified as having no difficulty in ADL function, having difficulty with one or more ADLs but able to perform ADLs without help, or needing help with at least one ADL (ADL dependence). This classification has been previously validated and strongly linked to survival.<sup>16</sup>
- Lee Index score, a validated prognostic score combining information on age and comorbidities and function that is strongly linked to survival.<sup>17</sup> Subjects were classified as having a score above or below 13—a score of 13 is associated with 59% mortality at 4 years and 91% at 10 years.

The prognostic indices used, including the Charlson and Lee Index and ADL assessments, have been extensively validated.<sup>14–17</sup>

### Statistical Analysis

Descriptive analyses were first performed summarizing the characteristics of the sample and the prevalence of the three treatments. Next, bivariate and multivariate analyses were conducted to examine the relationship between various prognostic characteristics and proportions of the three procedures. Because surgery is more intensive than nonsurgical treatments, rates of surgical procedures (excision and MMS) and nonsurgical procedures (ED&C) were compared. Differences between MMS and non-MMS procedures were also calculated. Chi-square tests were used for bivariate analyses. To estimate risk ratios directly instead of odds ratios, modified Poisson regression was used in multivariate analysis.<sup>18,19</sup> All analyses were conducted at the skin cancer treatment level but also accounted for clustering of treatments within individual participants. In multivariate analyses, treatment choice was used as the outcome variable and age ( $<75$ ,  $75-85$ ,  $\geq 85$ ), sex, income and net worth (dichotomized at median), comorbid conditions, and functional status (not dependent in any, dependent in one, dependent in two or more) as the predictor variables. Analyses were performed using SAS version 9.3 (SAS Institute Inc., Cary, NC) and Stata version 12.1 (Stata Corp., College Station, TX).

### RESULTS

Table 1 shows the descriptive characteristics of the study participants ( $N = 9,653$  claims from  $N = 2,702$  participants). Most participants were older men (63% men, mean age 79) with sociodemographic and medical characteristics representative of this age group nationally. Nineteen percent of participants had some difficulty in at least one ADL, 30% had a Charlson score of 3 or greater, and 14% had a Lee index of 13 or greater.

Table 2 shows the proportion of participants in the sample treated with each of the three most-common procedures. Sixty-one percent of tumors underwent surgery (19% MMS, 42% excision); the remaining 39% were treated using ED&C. No significant difference was noted in treatment rates in groups divided according to advanced age, medical comorbidities, indicators of limited life expectancy, or difficulty or dependence in ADLs. Of participants who died within 1 year of treatment, 15% underwent MMS (vs 17% of those who lived longer,  $P = .34$ ), and 51% underwent excision (vs 43% of those who lived longer,  $P = .06$ ).

**Table 1. Characteristics of 2,702 Participants Treated for Skin Cancer: 1992–2008 (N = 9,653 Skin Cancer Treatments)**

Characteristic	Value
Male, %	62.9
Age, mean (IQR)	79.2 (65–106)
Income, \$, mean (IQR)	37,000 (22,000–66,000)
Wealth, \$, mean (IQR)	330,000 (127,000–775,000)
Comorbid diseases, %	
Hypertension	57.4
Diabetes mellitus	14.8
Lung disease	9.2
Cancer (except skin)	24.9
Stroke	12.6
Heart disease	36.6
Activities of daily living, %	
No difficulty	80.6
Difficulty in $\geq 1$	12.6
Dependent in $\geq 1$	6.8
Dressing	
No difficulty	90.5
Difficulty in $\geq 1$	5.3
Dependent in $\geq 1$	4.2
Eating	
No difficulty	96.6
Difficulty in $\geq 1$	1.5
Dependent in $\geq 1$	1.9
Bathing	
No difficulty	93.4
Difficulty in $\geq 1$	2.8
Dependent in $\geq 1$	3.8
Using toilet	
No difficulty	93.5
Difficulty in $\geq 1$	4.9
Dependent in $\geq 1$	1.6
Walking across room	
No difficulty	92.2
Difficulty in $\geq 1$	5.0
Dependent in $\geq 1$	2.8
Transferring in or out of bed	
No difficulty	95.0
Difficulty in $\geq 1$	2.9
Dependent in $\geq 1$	2.1
Prognostic indices, %	
Charlson Comorbidity Index score <sup>15</sup>	
$<3$	70.1
$\geq 3$	29.9
Lee Index <sup>17</sup>	
$<13$	85.6
$\geq 13$	14.4

IQR = interquartile range.

**Table 2. Proportion (%) of Participants Treated with Each of the Three Most Common Procedures**

Characteristic	Total N = 9,653	MMS, n = 1,796	Excision, n = 4,066	Electrodesiccation and Curettage, n = 3,791	P-Value <sup>a</sup>
<b>Age</b>					
<75	2,979	18.9	43.1	38.0	.34
75–85	4,403	17.4	41.7	40.9	
≥85	2,271	20.6	41.7	37.7	
<b>Last year of life</b>					
No	8,051	17.2	42.9	39.9	.34
Yes	451	14.9	51.2	33.9	
<b>Comorbidities</b>					
<b>Hypertension</b>					
No	4,110	18.3	42.7	39.0	.81
Yes	5,540	18.8	41.7	39.5	
<b>Diabetes mellitus</b>					
No	8,219	18.1	42.0	40.0	.07
Yes	1,432	21.7	43.0	35.3	
<b>Lung disease</b>					
No	8,763	18.4	42.1	39.5	.32
Yes	888	20.9	42.0	37.0	
<b>Cancer (except skin)</b>					
No	7,234	18.0	42.5	39.5	.15
Yes	2,400	20.5	41.2	38.3	
<b>Stroke</b>					
No	8,435	18.4	42.6	39.0	.50
Yes	1,214	20.0	38.6	41.4	
<b>Heart disease</b>					
No	6,116	17.8	43.8	38.4	.20
Yes	3,532	20.1	39.2	40.7	
<b>Prognostic indices</b>					
<b>Lee Index</b>					
<13	8,266	18.6	41.9	39.5	.93
≥13	1,387	26.0	43.3	37.9	
<b>Charlson Comorbidity Index</b>					
<3	6,764	17.7	42.0	40.3	.08
≥3	2,889	20.6	42.5	36.9	
<b>Activities of daily living</b>					
<b>Summary</b>					
No difficulty	7,778	18.6	42.6	38.8	.90
Difficulty or dependent	1,859	18.8	39.9	41.3	
<b>Bathing</b>					
No difficulty	8,989	18.7	42.0	39.3	.44
Difficulty or dependent	640	16.9	43.3	39.8	
<b>Dressing</b>					
No difficulty	8,713	18.3	42.3	39.4	.33
Difficulty or dependent	916	21.1	40.4	38.5	
<b>Eating</b>					
No difficulty	9,296	18.7	42.2	39.1	.45
Difficulty or dependent	332	16.3	38.9	44.9	
<b>Transferring in or out of bed</b>					
No difficulty	9,149	18.5	42.2	39.3	.25
Difficulty or dependent	482	21.6	39.0	39.4	
<b>Using toilet</b>					
No difficulty	8,968	18.8	42.4	38.8	.41
Difficulty or dependent	628	16.6	36.6	46.8	
<b>Walking across room</b>					
No difficulty	8,873	18.6	42.1	39.3	.93
Difficulty or dependent	751	18.9	41.0	40.1	

<sup>a</sup>P-value for comparison between those who underwent Mohs micrographic surgery (MMS) and those who did not.

Rates of MMS were the same in participants with and without limited life expectancy even after adjusting for age, sex, socioeconomic status, medical comorbidities, and ability to perform ADLs (Table S1).

## DISCUSSION

Life expectancy should influence choice of treatment for BCC and SCC at least in part because KC is a nonfatal

disease in which the risks of intensive treatment may outweigh the benefits in some individuals who have few years to live. This nationally representative study of older Americans found that individual prognostic characteristics did not influence choice of type of KC treatments. In particular, life expectancy, whether measured according to advanced age, severe medical comorbidities, or impaired functional status, does not seem to influence treatment choice, including rates of MMS. Rates of MMS in participants who died within 1 year of treatment were similar to rates of those who lived longer, and rates of excision were higher in those who died within 1 year. These findings suggest that skin cancer treatment choice may not be customized to life expectancy and functional status.

These findings build on a prior single-city study showing that life expectancy does not influence treatment choice, even after adjusting for tumor characteristics (histology, location, degree of invasiveness). Their tumors did not bother 72% of participants and that 43% of participants died of unrelated causes within 5 years, whereas no participants died of KC.<sup>6</sup> Moreover, fewer than 5% of these tumors recur regardless of treatment type.<sup>3</sup> Meanwhile, 27% of participants reported a problem after treatment procedures (27%).<sup>6</sup>

There are selected circumstances in which a KC should be treated aggressively, even in individuals with limited life expectancy. In some cases, a KC can cause cosmetic distress or symptoms or ulcerate. Even in such a KC does not affect life expectancy, whichever treatment best treats the symptoms is indicated. Claims data did not have information on symptoms, so some of the MMS resections may have been indicated, even in those with limited life expectancy, but prior research demonstrates that the majority of KCs cause no symptoms, and in this case, treatments that are the least burdensome to the individual should be given special consideration.

A major limitation of this study is that only skin cancers that were treated using a procedure were included, because the sample was defined according to Medicare procedure codes. Therefore, untreated tumors and tumors treated using topical therapies (e.g., imiquimod) or radiotherapy are not included. Because the dataset did not include untreated tumors, these findings pertain to decision-making after a decision to treat a tumor and do not address the decision to treat itself, although based on other studies, it is likely that the proportion of untreated tumors in the United States is small,<sup>11,20</sup> and imiquimod and radiotherapy were rare modes of treatment in the years studied. Although limited life expectancy was not found to be associated with treatment decisions, a limitation of this study is that whether the treatments offered were appropriate could not be assessed. It is possible that invasive procedures were appropriate, even at the end of life, because they were used on medically dangerous or symptomatic tumors. Information was not available on many factors that may have influenced treatment choices, including tumor histology, location, and size. Information was not available on participant preferences either, and it is possible that some elderly adults would have requested more-intensive treatment options for their BCC. Furthermore, only procedures for KC were evaluated and not the more-recent topical treatments, including imiquimod and

5-fluorouracil. The KC selection criteria relied on procedure codes and therefore would not capture untreated tumors, although this is probably a small proportion of KCs.<sup>11</sup> Information was not available on the specialties of the physicians treating these tumors.

Despite these limitations, the main advantage of this study was that it included nationally representative data spanning 16 years. Taken together with a prior cohort study, which included detailed information on tumor and participant characteristics,<sup>11</sup> it is likely that there was an accurate picture of U.S. patterns of skin cancer treatment in individuals with differing life expectancies. Determining appropriate care of nonfatal conditions for individuals with limited life expectancy is challenging.<sup>21</sup> For example, rates of prostate cancer screening in individuals with limited life expectancy are probably excessive, given the known risks of screening and limited benefits of treatment.<sup>22,23</sup> Similarly, a significant proportion of individuals with metastatic cancer receive routine screening tests that are unlikely to provide any benefit.<sup>24</sup> A study of Medicare beneficiaries showed that more than 30% underwent surgery in the last year of life.<sup>25</sup> The current study adds to the growing argument for prudent use of procedures toward the end of life.

## CONCLUSION

Many characteristics, including advanced age, functional status, medical comorbidities, and life expectancy, do not affect choice of treatment for BCC and SCC. A more-individualized approach to skin cancer treatment may be preferred and provide better care for frail elderly adults. Although it is impossible to predict any individual's precise life expectancy, and advanced age alone should not dictate or restrict treatment options because life expectancy varies tremendously in those of similar age, it is possible that some individuals would choose less-invasive treatment if they were given all relevant information. It is also possible that physicians would make different recommendations if they had more guidance (including decision tools or evidence-based guidelines) on this topic. It is hoped that this study will add to the debate about optimal treatment decisions at the end of life.

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**Conflict of Interest:** Dr. Mary-Margaret Chren is a consultant for the Genentech Corporation. No other authors have conflicts of interest with the material in this article.

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## SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

**Table S1.** Multivariate Relative Risk of Undergoing Mohs Micrographic Surgery for Skin Cancer According to Prognostic Characteristics

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