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Original article

The burden of illness associated with renal cell carcinoma in the United States☆

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Abstract

Background: There were over 36,000 new cases of kidney cancer reported in the United States in 2004, the most common type being renal cell carcinoma (RCC). Available treatments for localized RCC frequently lead to cure; however RCC patients with advanced disease have limited treatment options and low survival rates. Data on the economic burden of RCC are limited.

Methods: A prevalence-based model was used to estimate the aggregate annual societal cost burden of RCC in the U.S., including costs of treatment and lost productivity. Key parameters in the model include: the annual number of patients treated for RCC by age group and cancer stage; utilization of cancer treatments; unit costs; work-days missed; and wage rates. Multiplying stratum-specific distributions of treatment by annual quantities of treatments and unit costs yields estimates of RCC-related health-care costs. Multiplying stratum-specific estimates of annual workdays missed by average wage rates yields estimates of RCC-related lost productivity.

Results: The annual prevalence of RCC in the U.S. was estimated to be 109,500 cases. The associated annual burden (inflated to 2005 U.S.$) was approximately $4.4 billion ($40,176 per patient). Health-care costs and lost productivity accounted for 92.4% ($4.1 billion) and 7.6% ($334 million), respectively. Reflecting its higher prevalence, the total cost associated with localized RCC accounted for the greatest share (78.2%), followed by regional, distant, and unstaged RCC, at 18.3%, 2.8%, and 0.7%, respectively.

Conclusions: The economic burden of RCC in the U.S. is substantial. Interventions to reduce the prevalence of RCC have the potential to yield considerable economic benefits.

Keywords: Renal cell carcinoma (RCC); Cost of illness; Burden of illness; Prevalence; Outcomes; Treatment patterns

1. Introduction

The American Cancer Society estimates that there were approximately 36,000 new cases of kidney cancer in the United States in 2004, the most common type (i.e., approximately 70%) being renal cell carcinoma (RCC) [1]. Kidney cancer ranks thirteenth in frequency among all cancers and accounts for about 3% of all human malignant tumors [2]. Over the last 2 decades, the incidence of kidney cancer in the U.S. increased by over 35% [2]. This increase may be due in part to improved diagnostic tests and better radiological techniques or more frequent ordering of such tests, including CT scans, MRI, and ultrasound, but also may reflect a real increase in incidence. Treatment options for patients with more localized cancer include radical or partial nephrectomy, radiofrequency ablation, and cryosurgery, all of which frequently lead to cure. However, patients with advanced RCC historically have had limited treatment options, including cytokine immunotherapy and chemotherapy; these treatments have low rates of effectiveness and are associated with severe side-effects. The absence of more effective treatment options contributes to the low survival rates among patients whose cancers spread—median survival for patients with advanced metastatic kidney cancer is estimated to be 8 to 12 months; 5-year survival among these patients is less than 10% [3,4].

Despite the growing importance of RCC, data on its economic burden are sparse. The U.S. Environmental Pro-

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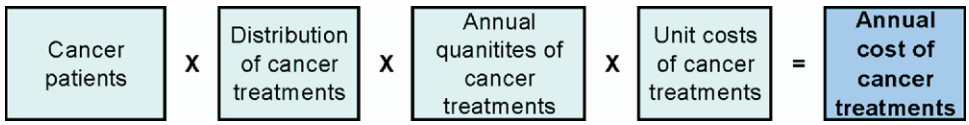

Fig. 1. Estimation of annual health-care costs among RCC patients. (Color version of figure is available online.)

tection Agency (EPA) maintains a cost-of-illness report, which contains estimates of selected direct costs associated with kidney cancer that are based on data more than 20 years old [5]. The EPA report relies solely on Medicare claims data, and does not address costs associated with medications or lost productivity. Using current and more comprehensive data, we developed a general prevalence-based cost of illness model to evaluate the annual societal economic burden of RCC (a subset of kidney cancer) in the U.S., including health-care costs and the value of lost productivity.

2. Methods

2.1. General model structure

The general modeling approach is illustrated in Fig. 1 and Fig. 2. The model begins with all RCC patients alive in a given year (i.e., the prevalence of RCC), stratified by age, gender, and cancer stage (i.e. localized, regional, distant, unstaged). This includes both newly diagnosed patients as well as patients diagnosed in previous years who are still alive in the study year. Patients in each stratum are assumed to use cancer-related health-care resources, which translate to health-care costs attributable to cancer. They also are assumed to have missed workdays (e.g., absenteeism and unemployment), which translate to lost productivity attributable to cancer.

These figures constitute simplified versions of the structural equations that are estimated in the model. Multiplying stratum-specific distributions of treatment by annual quantities of RCC treatments and unit costs yields stratum-specific estimates of annual health-care costs associated with RCC. Similarly, multiplying stratum-specific estimates of annual workdays missed by average wage rates yields stratum-specific estimates of lost productivity associated with RCC. Summing these estimates across strata yields an estimate of the total annual burden attributable to RCC.

2.2. Model estimation

2.2.1. RCC prevalence

The annual prevalence of RCC in each stratum was estimated using SEER-Stat software from the Surveillance Epidemiology and End Results (SEER) Program of the National Cancer Institute [6], which is an epidemiologic surveillance system consisting of population-based tumor registries designed to track cancer incidence and survival in the U.S. The registries collect information on cancer patients in geographically defined metropolitan areas currently representative of approximately 25% of the U.S. population.

RCC cases were selected as those with a first cancer site coded as "kidney" and the presence of an ICD-0-3 histology code indicating RCC (i.e.. 8310, 8312, and/or 8316–8319). All incidence estimates were inflated to be reflective of the entire U.S. RCC population. RCC prevalence was calculated as the product of incidence and median survival estimated with SEER-Stat. For all strata in which median survival was less than 1 year, prevalence was assumed to equal incidence in order to ensure that all patients who were alive at least 1 day during the study year were captured in the analysis.

The total annual prevalence of RCC was estimated to be 109,569, with 59% aged less than 65 years. Among patients under age 65, the distribution by cancer stage included approximately 80% with localized cancer, 16% with regional cancer, 3% with distant/metastatic cancer, and 1% with unstaged cancer. Among patients 65 years and older, the distribution included 75% with localized cancer, 18% with regional cancer, 5% with distant cancer, and 2% with unstaged cancer.

2.2.2. Health-care utilization and unit costs

The linked SEER-Medicare database, a collaborative effort of the National Cancer Institute, the SEER cancer registries, and the Centers for Medicare and Medicaid Services, was the primary source used to estimate distributions of health-care utilization, quantities of treatment, and unit costs among RCC patients.

2.2.2a. Description of the SEER-Medicare database. The linked SEER-Medicare data include a SEER file of Medicare-covered patients (i.e., primarily aged 65 years and older) diagnosed with cancer within the geographic areas covered by SEER registries, as well as Medicare claims for both cancer patients and a 5% sample of Medicare-eligible noncancer controls. The SEER file includes demographics (e.g., age, sex, race, date of death), SEER diagnostic information for up to 10 different incident cancer cases for each

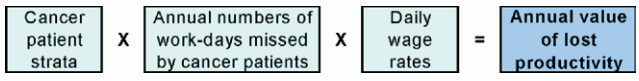

Fig. 2. Estimation of annual value of lost productivity among RCC patients. (Color version of figure is available online.)