CHAPTER 10

Kidney Cancer

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INTRODUCTION

Kidney cancer, the third most common urologic malignancy and the seventh most common cancer overall, was diagnosed in an estimated 35,000 Americans in 2005, and nearly 13,000 died from it (1). That year, kidney cancer constituted 3% of new cancer cases and 3% of all cancer deaths in men. Kidney cancer occurs about half as often in women and constitutes less than 2% of female cancer cases and deaths (1). When discovered in its early stages, the disease is curable, but metastatic kidney cancer is usually fatal. Fortunately, the recent increase in kidney cancer incidence reflects primarily small tumors discovered incidentally during abdominal imaging. Table 1 lists the diagnosis and procedure codes associated with kidney cancer.

Kidney cancer imposes a significant burden on the US healthcare system, as its diagnosis involves advanced radiologic testing and its treatment often involves surgery, hospitalization, and regular surveillance visits to assess for recurrence. These interventions result in loss of work time and regular activity, not only for the patient but also for family members providing support. Currently, less than 1% of visits to urologists are for the treatment of kidney cancer (Table 2).

DEFINITION AND DIAGNOSIS

The term *kidney cancer* generally refers to any cancer arising in the kidney or renal pelvis, but most of the tumors considered in this analysis are renal cell carcinomas (RCCs), which arise from cells in the tubules of the filtration portion of the kidney. RCC itself includes a variety of distinct biological and disease entities (2). In adults, most kidney cancers are classified as conventional or clear cell RCC and are associated with a defect in the von Hippel-Lindau tumor suppressor gene. This genetic defect can be inherited but usually occurs spontaneously. Each of the other subtypes (papillary RCC, chromophobe RCC, and collecting duct RCC) has a unique genetic abnormality and exhibits different biologic behavior. In children, the most common form of kidney cancer is Wilms' tumor, which also exhibits unique genetic abnormalities and biologic behavior. Wilms' tumors are quite rare and contribute little to the incidence data in current datasets. Transitional cell carcinomas involving the kidney are excluded from the analysis in this chapter whenever possible, because they originate in the urothelial lining of the renal pelvis rather than the filtration component of the kidney. These cancers have various risk factors, exhibit different biologic behavior, and have different treatment options; they are discussed in the bladder and upper tract urothelial cancer chapter of this compendium.

More than 50% of kidney cancers are diagnosed incidentally by abdominal imaging (computed tomography (CT), magnetic resonance imaging (MRI), or ultrasound) performed for unrelated reasons (3). Nonspecific symptoms such as fatigue, weight loss, and peripheral edema may also lead to an evaluation that identifies a kidney cancer. Less commonly, symptoms such as flank pain, hematuria, and/or a flank mass will lead to evaluation that identifies a kidney tumor.

Table 1. Codes used in the diagnosis and management of kidney cancer

Individuals 35 years or older, with one or more of the following:	
ICD-9 diagnosis codes	
189	Malignant neoplasm of kidney and other unspecified organs
189.0	Malignant neoplasm of kidney, except pelvis
189.8	Malignant neoplasm of other specified sites of urinary organs
CPT procedure codes	
50230	Nephrectomy, including partial ureterectomy, any open approach including rib resection; radical, with regional lymphadenectomy and/or vena caval thrombectomy
50240	Nephrectomy, partial
50543	Laparoscopy, surgical; partial nephrectomy
50545	Laparoscopy, surgical; radical nephrectomy (includes removal of Gerota's fascia and surrounding fatty tissue, removal of lymph nodes, and adrenalectomy)

The so-called "classic triad" of symptoms of kidney cancer—hematuria, flank pain, and a mass—occurs rarely (< 10%) and inevitably indicates the presence of advanced disease (4). When such symptoms cause suspicion, X-rays (e.g., intravenous pyelography), CT, MRI, and ultrasound may be utilized to identify tumors and determine their extent. Both CT and MRI are highly sensitive means of identifying the characteristics of kidney cancer, although only removal of the lesion and pathological evaluation are considered diagnostic. Of these, contrast-enhanced CT is the most commonly used modality. Non-excisional biopsy of the tumor is pursued only in rare instances with renal masses of diagnostic uncertainty.

Staging for local extension or metastatic disease is critical in all cases of suspected kidney cancer (Table 3). A chest X-ray (or chest CT) and blood tests are performed to check for lung metastases and paraneoplastic syndromes, respectively. Additionally, if signs or symptoms raise concern for bone metastasis, a bone scan is obtained, and if neurologic symptoms are present, CT or MRI of the brain is obtained. Staging is described by the TNM system that is standard practice in the United States, where the T stage is based on the

Table 2. Physician office visits to urologists, count, percent

Primary diagnosis	1992–2000 Count	1992–2000 Percent
Total	50,191,441	100
Kidney Cancer	383,886	< 1

SOURCE: National Ambulatory Medical Care Survey, 1992, 1994, 1996, 1998, 2000.

Table 3. TNM staging system for kidney cancer

Primary Tumor (T)	
TX:	Primary tumor cannot be assessed
T0:	No evidence of primary tumor
T1:	Tumor ≤ 7 cm in greatest dimension, limited to the kidney
T1a:	Tumor ≤ 4 cm in greatest dimension, limited to the kidney
T1b:	Tumor > 4 cm but ≤ 7 cm in greatest dimension, limited to the kidney
T2:	Tumor > 7 cm in greatest dimension, limited to the kidney
T3:	Tumor extends into major veins or invades adrenal gland or perinephric tissues but not beyond Gerota's fascia
T3a:	Tumor directly invades adrenal gland or perirenal and/or renal sinus fat but not beyond Gerota's fascia
T3b:	Tumor grossly extends into the renal vein or its segmental (i.e., muscle-containing) branches, or the vena cava below the diaphragm
T3c:	Tumor grossly extends into the vena cava above the diaphragm or invades the wall of the vena cava
T4:	Tumor invades beyond Gerota's fascia
Regional lymph nodes (N)	
NX:	Regional lymph nodes cannot be assessed
N0:	No regional lymph node metastasis
N1:	Metastasis in a single regional lymph node
N2:	Metastasis in more than 1 regional lymph node
Distant metastasis (M)	
MX:	Distant metastasis cannot be assessed
M0:	No distant metastasis
M1:	Distant metastasis
Histological grading	
GX:	Grade of differentiation cannot be assessed
G1:	Well differentiated
G2:	Moderately differentiated
G3-4:	Poorly differentiated/undifferentiated

Source: Adapted from Kidney. In: American Joint Committee on Cancer.: AJCC Cancer Staging Manual. 6th ed. New York, NY: Springer, 2002, 323–328.

size of the tumor and whether it has extended directly beyond the kidney, N denotes the presence of lymph node involvement, and M denotes metastasis to other parts of the body.

RISK FACTORS

The cause of kidney cancer is not known. Epidemiologic evidence indicates that age beyond 50 years, male gender, and end-stage renal disease are risk factors for developing kidney cancer. Other risk factors include smoking (5), obesity (6), hypertension, and work-related exposures to certain substances, such as leather dyes, cadmium, petroleum products, and asbestos (6). In addition, medications, such as diuretics, and dietary factors, including coffee consumption, high-fat and high-protein (7) diets, and high consumption of red and processed meat (8), have been associated with kidney cancer (9, 10). Interestingly, alcohol consumption is weakly associated with a decreased risk of kidney cancer (11, 12). Despite these associations, no definite causal relationship has been established.

While the specific causes of kidney cancer are unknown, genetic abnormalities are consistently present in each histologic subtype. Patients with a family history of any of these abnormalities have a substantially increased risk of kidney cancer, but hereditary kidney cancer contributes only minimally to the overall incidence of the disease (13). Most likely, kidney cancer is caused by a combination of sporadic genetic events, environmental exposures, and patient factors (14, 15).

TREATMENT

Surgery is the primary treatment for non-metastatic kidney cancer. Surgical removal is the standard of care for tumors confined to the kidney (T1 and T2 cancers), for T3a tumors that have perforated into the fatty tissue around the kidney, and for T3b and T3c tumors that have extended into the venous system.

Several non-surgical alternatives are available for patients who are unsuitable surgical candidates or who are unwilling to have surgery. One alternative is arterial embolization, in which the blood supply to the tumor or to the entire kidney is blocked. In the past decade, less-invasive percutaneous thermal therapies have been developed (e.g., cryotherapy and radiofrequency ablation) that appear in early studies to be effective in selected cases (16). Finally, in very elderly patients who have severe medical comorbidity, kidney tumors may simply be managed expectantly with serial X-rays and clinical follow-up.

Radiation therapy is not effective for kidney cancer except to palliate the pain associated with bone metastases. Chemotherapy also has not been effective in treating this disease, although recent clinical trials show some promise. Over the past several years, intense research has focused on manipulating the immune system to help fight metastatic kidney cancer. As a result, immunotherapy with interleukin-2 or interferon alpha is often used, but with limited success. There appears to be a survival benefit from removal of the kidney tumor (cytoreductive surgery) before immunotherapy for patients with metastatic disease and good functional status (17, 18). In addition, clinical trials for metastatic kidney cancer generally mandate removal of the kidney. Finally, surgical removal of solitary metastatic lesions has shown a survival benefit, particularly in the case of lung lesions (19, 20).

A new agent, sorafenib tosylate (Nexavar™) (21), was approved in 2005 for the treatment of patients with metastatic kidney cancer. In the drug class known as tyrosine kinase inhibitors, it works by inhibiting angiogenesis, the growth of blood vessels, induced by the cancer. In the clinical trial leading to FDA approval, the drug doubled survival time from three to six months. A similar agent, sunitinib malate (Sutent™) (22), was approved in 2006 to treat patients with metastatic kidney cancer. Both of these medications have been shown to extend progression-free survival and continue to be evaluated for their effect on overall survival. In addition, studies are ongoing to evaluate these agents in combination with other agents to further improve the survival of patients with metastatic renal cell carcinoma. It is important to note that both sorafenib and sunitinib do not usually cause disappearance of metastatic lesions as is the traditional goal of chemotherapy, but rather cause stabilization of the disease by arresting further growth and spread. Furthermore, these agents are expensive and cost thousands of dollars per month and treatment duration is indeterminate at this time.

Table 4. Incidence rates of kidney cancer, age-adjusted, by race/ethnicity and gender

	All			Whites			Blacks		
	Total	Males	Females	Total	Males	Females	Total	Males	Females
Year of Diagnosis									
1975	7.1	10.3	4.5	7.3	10.8	4.6	6.2	8.2	4.3
1976	8.0	11.2	5.5	8.1	11.5	5.6	7.8	11.6	4.8
1977	8.1	11.4	5.5	8.1	11.7	5.5	8.5	11.1	6.4
1978	7.8	11.8	4.8	8.0	12.1	4.9	8.0	11.0	5.7
1979	7.6	11.1	5.0	7.8	11.6	5.1	7.3	8.2	6.3
1980	8.1	11.7	5.4	8.4	12.2	5.6	6.0	8.0	4.4
1981	8.5	12.8	5.3	8.6	13.0	5.3	10.0	15.8	5.8
1982	8.3	11.8	5.7	8.5	12.0	5.8	7.6	11.2	4.9
1983	8.9	13.2	5.7	9.2	13.8	5.8	8.8	13.5	5.5
1984	9.2	13.1	6.2	9.5	13.6	6.3	9.0	12.0	6.8
1985	8.9	13.1	6.8	9.2	13.6	5.9	8.6	11.6	6.2
1986	9.7	13.8	6.6	9.8	14.1	6.7	10.1	15.0	6.6
1987	9.9	14.1	6.7	10.1	14.4	6.9	11.1	15.6	7.8
1988	9.9	14.0	7.0	10.1	14.3	7.0	11.5	15.2	8.8
1989	10.3	14.5	7.1	10.6	15.0	7.2	10.8	15.1	7.8
1990	10.4	14.7	7.1	10.7	15.0	7.4	10.6	16.1	6.6
1991	10.6	15.0	7.2	10.8	15.2	7.4	12.2	18.3	7.5
1992	10.7	15.2	7.4	11.1	16.6	7.7	10.9	16.3	7.2
1993	10.7	14.6	7.6	10.8	14.7	7.7	12.7	17.3	9.4
1994	11.3	15.6	7.8	11.5	19.9	8.0	12.7	18.0	8.6
1995	11.1	15.5	7.6	11.1	15.4	7.7	14.4	21.7	9.3
1996	11.3	15.8	7.9	11.4	16.1	7.8	13.5	17.0	10.9
1997	10.9	15.0	7.6	11.0	15.0	7.7	13.4	19.2	9.2
1998	11.8	16.4	8.2	12.1	16.8	8.4	12.6	16.9	9.2
1999	11.4	15.8	7.8	11.6	16.1	8.0	13.5	18.5	9.9
2000	12.3	17.1	8.4	12.5	17.7	8.3	14.6	19.0	11.8
2001	12.0	16.7	8.3	12.2	16.9	8.5	14.5	20.9	9.9
Age at Diagnosis									
All Ages	11.7	16.2	8.1	11.9	16.5	8.2	13.7	18.9	10.0
< 65	6.1	8.2	4.2	6.2	8.2	4.2	7.5	9.8	5.5
> 65	50.0	71.8	34.8	51.2	73.5	35.6	56.9	81.7	41.0
All Ages[a]	8.2	11.2	5.7	8.4	11.4	5.8	9.8	13.3	7.2

In this table, approximately 12% are renal pelvis cancers.

[a]SEER 9 areas. Rates are per 100,000 and are age-adjusted to the International Agency for Research on Cancer (IARC) world standard population.

SOURCE: Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) 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.

These agents will likely have a significant effect on survival from kidney cancer and costs associated with treatment over the next several years, but these are not reflected in the datasets used in this chapter.

Several surgical techniques are used to remove kidney cancers. Radical nephrectomy involves the removal of the entire kidney, its surrounding fatty tissue known as Gerota's fascia, and the nearby adrenal gland. Partial nephrectomy entails removing the entire tumor with a margin of normal kidney but sparing the remainder of the normal kidney and is associated with good long-term results (18). This procedure is technically more challenging than radical nephrectomy and has a higher risk of significant blood loss. Partial nephrectomy, or "nephron-sparing" surgery, is increasingly utilized for T1 tumors and, when technically feasible, for higher-stage tumors in the setting of bilateral disease, solitary kidney, or systemic disease that affects renal function (e.g., diabetes, hypertension).

During the 1990s, the evolution of laparoscopy transformed kidney cancer surgery. This technique involves making several buttonhole-size incisions and inserting a lighted scope and instruments to permit the surgery without making the traditional, larger incision. After the kidney is dissected free, it is usually removed through an incision made lower in the abdomen. Because of the size and location of the incision, pain is decreased and cosmesis is improved. First used for operations such as gallbladder removal, this technique was applied to kidney surgery in the 1990s and has been shown to decrease pain and speed the return to normal activity. Both radical and partial nephrectomy are now performed laparoscopically at many university centers and many non-academic centers as an evolving standard of care. To investigate

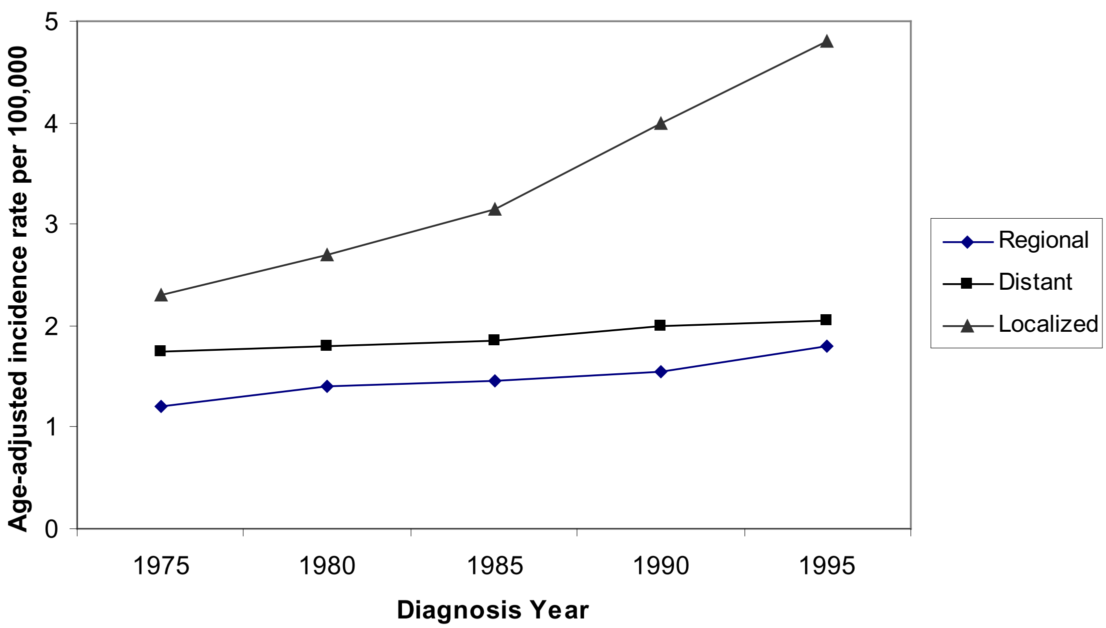

Figure 1. Age-adjusted incidence rates for kidney cancer per 100,000 population, by stage, 1973–1998 (SEER).

In this figure, approximately 12% are renal pelvis cancers. Values over curves indicate annual percent change per 100,000 population. Values in parentheses indicate 95% CI.

SOURCE: Adapted from Journal of Urology, 167, Hock LM, Lynch J, Balaji KC. Increasing incidence of all stages of kidney cancer in the last 2 decades in the United States: an analysis of surveillance, epidemiology and end results program data, 57–60, Copyright 2002, with permission from American Urological Association.

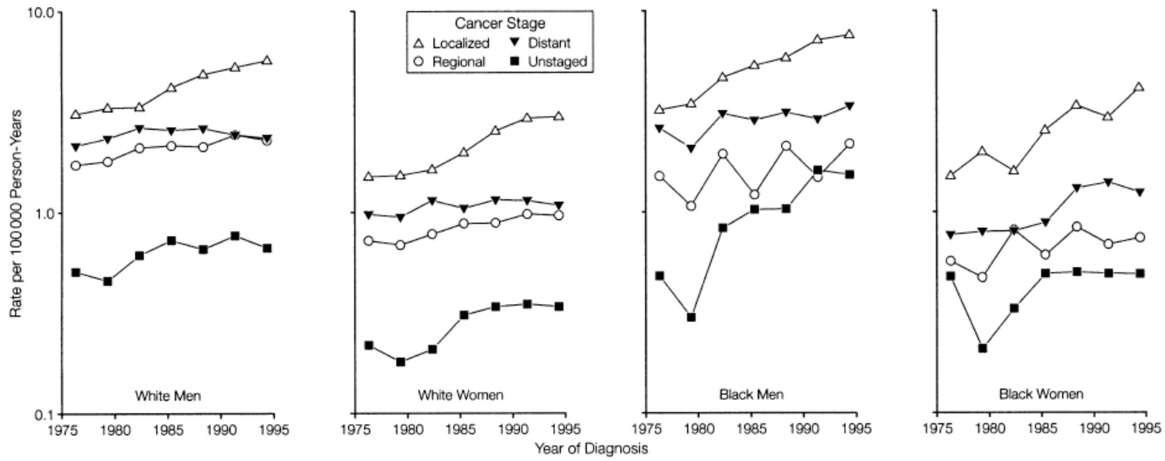

Figure 2. Age-adjusted incidence rates per 100,000 person-years for kidney cancer, by gender, race/ethnicity, and tumor stage at diagnosis, 1975–1977 and 1993–1995 (SEER).

In this figure, approximately 12% are renal pelvis cancers.

SOURCE: Adapted from Journal of the American Medical Association, Chow WH, Devesa SS, Warren JL, Fraumeni JF, Jr. Rising incidence of renal cell cancer in the United States. 1999;281(17):1628–1631, with permission from American Medical Association.

this further, the Urology Residency Review Committee evaluated the surgical database for residents completing training in 2005 (23). CPT codes for laparoscopic nephrectomy, laparoscopic radical nephrectomy, laparoscopic partial nephrectomy, and laparoscopic nephroureterectomy were used. Residents completing four-year urology training programs reported performing an average of 24 of these procedures, with a median of 26.

While the analysis in this chapter is based on the most complete and updated information available regarding the utilization of US healthcare for the treatment of kidney cancer, some important limitations exist. Data are not yet available to describe fully the recent widespread adoption of laparoscopic techniques in kidney cancer surgery, although relevant information is included where possible. Finally, the datasets do not capture non-surgical treatments such as thermal therapy and immunotherapy, because their use is either too recent or uncommon.

INCIDENCE AND PREVALENCE

Incidence

Several excellent resources provide insight into the incidence and prevalence of kidney cancer in the United States. The best sources of information are the Surveillance, Epidemiology, and End Results (SEER) database and the American Cancer Society Surveillance Research Cancer Statistics, both of which show an increasing incidence of kidney cancer over the past three decades. While most of the increased incidence is seen in small, organ-confined disease, there is also a significant increase in the incidence of locally advanced and metastatic disease (Figures 1 and 2).

An important question raised by these data is whether the increased incidence of RCC is due to a real increase in the disease burden or simply to increased detection. The answer appears to be both. In addition, the SEER data reflect an increase in the treatment of RCC. However, the SEER data do not capture cases that are diagnosed radiographically if the tumors are not biopsied or removed; therefore, the incidence is inherently underestimated in this dataset. Certainly, more tumors are diagnosed incidentally through abdominal imaging that is performed for other reasons. A typical scenario is that of a patient who visits the doctor because he is experiencing abdominal pain and subsequently undergoes an abdominal CT for further evaluation. A kidney tumor is identified but is not believed to be the cause of the pain, and the

Table 5. Incidence rates of kidney cancer, age-specific[a], by race/ethnicity and gender

	All			Whites			Blacks		
	Total	Males	Females	Total	Males	Females	Total	Males	Females
Age at Diagnosis									
< 1	1.7	…	…	…	…	…	…	…	…
1–4	2.1	1.9	2.4	2.4	2.2	2.6	…	…	…
5–9	0.6	…	0.7	0.5	…	…	…	…	…
10–14	…	…	…	…	…	…	…	…	…
15–19	…	…	…	…	…	…	…	…	…
20–24	0.3	…	…	…	…	…	…	…	…
25–29	0.5	0.6	…	0.5	…	…	…	…	…
30–34	1.3	1.4	1.2	1.2	1.3	1.1	2.0	…	…
35–39	2.8	3.2	2.4	2.7	3.2	2.3	3.7	…	3.6
40–44	5.7	7.3	4.2	5.7	7.3	4.0	7.6	8.9	6.4
45–49	9.7	13.6	6.0	10.0	14.0	6.1	9.4	14.5	5.0
50–54	15.8	22.0	9.8	15.9	22.0	9.9	21.3	30.3	13.6
55–59	25.8	35.1	17.0	26.3	35.5	17.3	31.7	41.8	23.3
60–64	35.2	48.2	23.4	35.9	48.9	23.7	40.7	54.9	29.4
65–69	45.1	60.9	31.6	46.4	61.8	33.0	52.8	78.6	33.5
70–74	53.2	75.5	35.8	54.7	77.3	36.6	91.9	86.3	45.4
75–79	54.1	77.9	37.3	55.5	80.3	38.2	61.4	84.3	47.0
80–84	54.6	82.7	37.7	55.5	84.3	38.2	61.2	102.2	39.9
> 85	42.0	65.2	32.3	42.1	67.6	31.9	42.8	…	39.8

…data not available.

In this table, approximately 12% are renal pelvis cancers.

[a]SEER 9 areas. Rates are per 100,000 and are age-adjusted to the 2000 US standard population by age groups.

SOURCE: Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) 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.

Table 6. Trends in incidence[a] of kidney cancer, 1975–2001, by race/ethnicity and gender

	Year	APC	Year	APC
Total				
Male and Female	1975–1990	2.4[b]	1990–2001	1.3[b]
Male	1975–1987	2.3[b]	1987–2001	1.2[b]
Female	1975–1992	2.3[b]	1992–2001	1.1[b]
White				
Male and Female	1975–1990	2.4[b]	1990–2001	1.2[b]
Male	1975–1987	1.6[b]		
Female	1975–1992	2.7[b]	1992–2001	0.9[b]
Black				
Male and Female	1975–1990	2.9[b]		
Male	1975–1987	2.8[b]		
Female	1975–1992	3.2[b]		

The APC is the Annual Percent Change based on rates age-adjusted to the 2000 US standard population by 5-year age groups.

In this table, approximately 12% are renal pelvis cancers.

[a]Trends are from the SEER 9 areas.

[b]The annual percent of change is significantly different from zero ($p < 0.05$).

SOURCE: Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) 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.

Table 7. Estimated annual percent change in incidence rate of kidney cancer, 1975–1998, by stage, age, and race/ethnicity

Stage	Age (yr)	Race	Estimated Annual Percentage of Change
Local	20–59	White	2.87
		Black	4.46
	60+	White	3.06
		Black	4.35
Regional/distant	20-59	White	0.08
		Black	0.12
	60+	White	0.15
		Black	1.82

SOURCE: Reprinted from Urology, 62, Vaishampayan UN, Do H, Hussain M, Schwartz K, Racial disparity in incidence patterns and outcome of kidney cancer, 1,012–1,017, Copyright 2003, with permission from Elsevier.

focus shifts to the treatment of the kidney mass. From the late 1980s into the 1990s, the rate of CT and MRI of the abdomen in Medicare patients nearly doubled, from 2,622 to 4,536 per 100,000 per year (24) and has remained at least as high since that time. Incidentally detected kidney tumors now constitute the majority of the presentations of RCC. Most of these are low-stage tumors, although many of higher stage are also detected incidentally.

With increasing detection of curable, small kidney tumors, one would expect to see a stage migration with a decrease in advanced disease and death rates. This occurred with prostate cancer screening after the advent of the prostate specific antigen blood test in the early 1990s. To date, however, there is limited evidence that it has occurred in kidney cancer (25). The rising rate of obesity (26) and hypertension (27), two known risk factors associated with kidney cancer, may play a role in the increased incidence.

The SEER data show that kidney cancer incidence rises with age—the vast majority of cases are diagnosed in patients over 65 (Table 4). Overall incidence in the United States is greater than that reported by international organizations such as the International

Table 8. Age-adjusted incidence[a] rates of kidney cancer, by race/ethnicity and gender

	Rate per 100,000 persons 1997–2001			Annual Percent Change 1992–2001		
Race/ethnicity	Total	Male	Females	Total	Male	Females
Total	11.3	15.7	7.8	1.4[c]	1.3[c]	1.5[c]
White	11.7	16.2	8.1	1.6[c]	1.4[c]	1.4[c]
White Hispanic[b]	11.5	15.5	8.5	1.9	1.1	2.9[c]
White Non-Hispanic[b]	11.5	16.0	7.8	1.7[c]	1.7[c]	1.4[c]
Black	13.3	18.8	9.4	2.2[c]	1.9	2.8[c]
Asian/Pacific Islander	6.4	8.9	4.3	1.4	0.4	3.1[c]
N. American Native/ Alaska Native	10.0	13.9	7.0	- 5.6[c]	- 5.9[c]	…
Hispanic[b]	11.2	15.1	8.2	2.2[c]	1.4	3.0[c]

…data not available.

In this table, approximately 12% are renal pelvis cancers.

[a]Incidence data are from the 12 SEER areas (San Francisco, Connecticut, Detroit, Hawaii, Iowa, New Mexico, Seattle, Utah, Atlanta, San Jose-Monterey, Los Angeles, and Alaska Native Registry.

[b]Hispanic and Non-Hispanic are not mutually exclusive from Whites, Blacks, Asian/Pacific Islanders, and American Indians/Alaska Natives. Incidence data for Hispanics and Non-Hispanics do not include cases from Detroit, Hawaii, and Alaska Native Registry.

[c]The APC annual percent change is significantly different from zero ($p < 0.05$).

SOURCE: Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) 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.

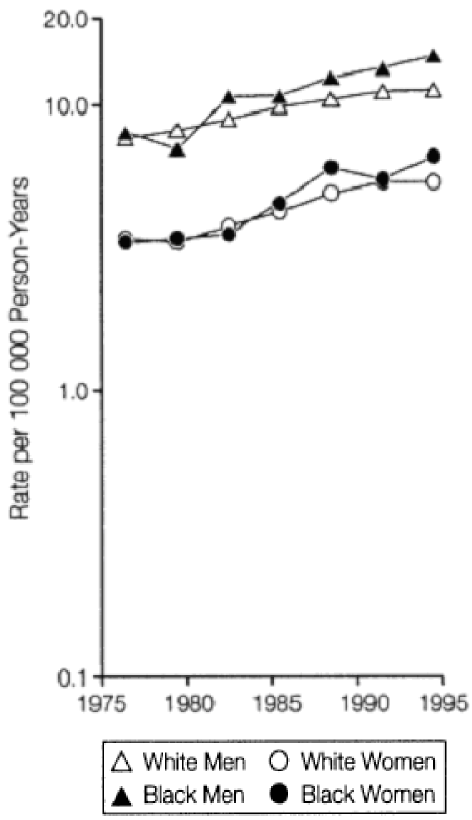

Figure 3. Age-adjusted incidence rates of kidney cancer per 100,000 person-years, by gender and race/ ethnicity, 1975–1977 to 1993–1995 (SEER).

In this figure, approximately 12% are renal pelvis cancers.

SOURCE: Adapted from JAMA, Chow WH, Devesa SS, Warren JL, Fraumeni JF, Jr. Rising incidence of renal cell cancer in the United States. 1999;281(17):1,628–1,631, with permission from American Medical Association.

Agency for Research on Cancer (IARC). SEER data also show that among men and women under the age of 65, the incidence is higher in African Americans than in Caucasians. Again, the reasons for this are unclear and may be related to comorbid conditions such as hypertension, which is more common in African Americans, or to genetic variations that have not yet been defined. In all groups, incidence rises with age up to the ninth decade of life (Table 5). As the US population ages, further increases in the incidence of kidney cancer are expected, with a corresponding increase in the burden of disease treatment on the US healthcare system.

Further analysis of the SEER data shows an overall rising trend in the incidence of kidney cancer, but the rates vary among demographic groups. Overall, the incidence of kidney cancer rose 2.4% per year from 1975 to 1990 and 1.3% per year from 1990 to 2001 (Table 6). While kidney cancer occurs approximately twice as often in men as in women, its rate is increasing in women as well (Tables 4 and 5). In addition, incidence is rising more quickly in African Americans than in Caucasians and most rapidly in African American women (Figures 2 and 3). When age and race are considered together, African American men under the age of 60 have the most rapid rise in incidence of RCC (Table 7).

SEER data provide limited information about other demographic groups. From 1997 to 2001, Asian/Pacific Islanders had a lower incidence of kidney cancer than did Caucasians and African Americans, but a rising rate of diagnosis was seen from 1992 to 2001 and is prominent in females. In Native Americans/Alaska Natives, the incidence approaches that of Caucasians, but the rate of cases is not increasing. The incidence of kidney cancer in Hispanics is similar to that in the Caucasian population, but over time, an increasing trend has been seen, particularly in females (Table 8).

Table 9. Prevalence[a] of kidney cancer on Jan 1, 2001

Total	210,994
Males	124,353
Females	86,641
White	185,924
Males	109,937
Females	75,987
Black	21,837
Males	11,106
Females	10,731

In this table, approximately 12% are renal pelvis cancers.

[a]US 2001 cancer prevalence counts are based on 2001 cancer prevalence proportions from the SEER registries and 1/1/2001 US population estimatesbased on the average of 2000 and 2001 population estimates from the US Bureau of the Census.

SOURCE: Ries, LAG., Eisner, MP, Kosary, CL, Hankey, BF, Miller, BA, Clegg, L, Mariotto, A, Feuer, EJ, Edwards, BK. SEER Cancer Statistics Review, 1975–2001, National Cancer Institute. Bethesda, MD, http://seer.cancer.gov/csr/1975_2001/2004.

Table 10. VA users with a diagnosis of kidney cancer, 1998–2003, count, age-adjusted rate[a]

	1998		1999		2000		2001		2002		2003	
	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate	Count	Rate
Total	5,041	147	5,570	152	6,002	154	6,912	162	7,903	169	9,250	186
Age-adjusted Total	6,028	155	6,057	156	6,002	154	6,078	156	6,195	159	6,713	173
Age												
< 25	0	0	3	7	2	5	0	0	1	3	1	3
25–34	20	10	19	9	18	9	22	11	19	9	21	11
35–44	118	29	128	31	134	32	135	33	150	36	150	36
45–54	777	91	848	99	854	100	918	107	918	107	1,021	119
55–64	1,248	196	1,232	193	1,245	195	1,236	194	1,265	198	1,349	211
65–74	2,223	228	2,256	232	2,140	220	2,182	224	2,182	224	2,409	247
75–84	1,537	219	1,456	207	1,495	213	1,479	211	1,555	222	1,648	235
85+	105	164	115	180	114	179	105	165	104	163	114	178
Gender												
Male	4,985	152	5,496	157	5,926	160	6,820	167	7,785	174	9,120	192
Female	56	37	74	45	76	43	92	49	118	59	130	61
Race/ethnicity												
White	3,843	176	4,267	180	4,605	178	5,389	187	6,113	195	6,788	213
Black	806	162	928	183	1,004	196	994	192	1,057	204	1,167	231
Hispanic	149	160	149	154	149	150	176	170	201	188	226	216
Other	52	118	75	163	66	137	73	145	93	180	99	196
Unknown	191	31	151	23	178	28	280	39	439	51	970	86
Insurance Status												
No insurance/ self-pay	3,258	129	3,520	133	3,504	135	3,675	141	3,974	149	4,268	160
Medicare	578	221	885	221	1,432	215	2,194	217	2,794	219	3,709	243
Medicaid	3	130	3	103	5	122	9	136	20	216	23	226
Private Insurance/ HMO	1,184	183	1,129	187	1,023	172	982	158	1,067	157	1,194	163
Other Insurance	18	148	33	174	38	148	47	159	44	131	52	131
Unknown	0	0	0	0	0	0	5	253	4	136	4	222
Region												
Eastern	679	137	777	146	825	143	1,104	157	1,328	165	1,497	181
Central	952	158	1,038	159	1,020	151	1,185	157	1,479	159	1,915	176
Southern	2,078	158	2,221	158	2,543	167	2,949	173	3,345	176	4,012	197
Western	1,332	130	1,534	142	1,614	145	1,674	151	1,751	167	1,826	180

[a]Rates are per 100,000 veterans using the VA system, age-adjusted to 2000.

SOURCE: Inpatient and Outpatient Files, VA Information Resource Center (VIReC), Veterans Affairs Health Services Research and Development Service Resource Center.

Table 11. Mortality rates[a] for kidney cancer, age-adjusted, by race/ethnicity and gender

	All			Whites			Blacks		
	Total	Males	Females	Total	Males	Females	Total	Males	Females
Year of diagnosis									
1975	3.6	5.2	2.4	3.7	5.3	2.5	2.8	4.1	1.8
1976	3.6	5.2	2.4	3.7	5.4	2.5	2.9	4.2	1.9
1977	3.7	5.4	2.4	3.8	5.5	2.5	2.9	4.0	2.0
1978	3.7	5.4	2.4	3.8	5.5	2.5	3.2	4.8	1.9
1979	3.6	5.3	2.4	3.7	5.5	2.4	2.9	4.2	2.0
1980	3.7	5.5	2.4	3.8	5.6	2.4	3.0	4.2	2.0
1981	3.7	5.4	2.5	3.8	5.5	2.6	3.2	4.6	2.1
1982	3.9	5.7	2.5	3.9	5.8	2.6	3.4	4.8	2.4
1983	3.8	5.6	2.6	3.9	5.7	2.7	3.3	4.8	2.1
1984	3.9	5.8	2.6	4.0	5.9	2.6	3.5	4.9	2.4
1985	4.0	5.8	2.7	4.0	5.8	2.7	3.8	6.0	2.4
1986	4.0	5.8	2.8	4.1	5.9	2.8	3.7	5.3	2.5
1987	4.1	6.0	2.8	4.2	6.1	2.8	3.7	5.5	2.4
1988	4.0	5.9	2.7	4.1	5.9	2.8	3.8	5.8	2.4
1989	4.2	6.1	2.8	4.2	6.2	2.8	4.0	6.1	2.6
1990	4.2	6.2	2.8	4.2	6.2	2.8	4.2	6.4	2.8
1991	4.3	6.2	2.9	4.3	6.2	3.0	4.3	6.4	3.0
1992	4.3	6.2	2.9	4.4	6.3	2.9	4.0	5.9	2.6
1993	4.2	6.1	2.8	4.2	6.2	2.8	4.1	3.1	2.7
1994	4.3	6.2	2.9	4.3	6.3	2.9	4.2	6.4	2.8
1995	4.3	6.2	3.0	4.4	6.3	3.0	4.4	6.3	3.1
1996	4.3	6.2	2.8	4.3	6.3	2.9	4.1	5.9	2.9
1997	4.3	6.2	2.9	4.3	6.2	2.9	4.3	6.5	2.8
1998	4.3	6.2	2.8	4.3	6.3	2.9	4.0	6.3	2.5
1999	4.1	5.9	2.7	4.1	6.0	2.7	4.2	6.1	2.8
2000	4.2	6.1	2.8	4.3	6.2	2.8	4.1	6.3	2.7
2001	4.3	6.2	2.8	4.3	6.3	2.8	4.3	6.4	2.8
Age at Diagnosis									
All Ages	4.2	6.1	2.8	4.3	6.2	2.8	4.2	6.3	2.7
< 65	1.6	2.3	1.0	1.6	2.3	1.0	1.8	2.7	1.1
> 65	22.1	32.5	15.3	22.5	33.0	15.6	20.7	31.7	14.2
All Ages	2.6	3.8	1.7	2.7	3.8	1.7	2.7	4.1	1.7

In this table, approximately 12% are renal pelvis cancers.

[a]SEER 9 areas. Rates are per 100,000 and are age-adjusted to the International Agency for Research on Cancer (IARC) world standard population.

SOURCE: Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) 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.

A weakness of the SEER dataset is its inclusion of cancer of the renal pelvis in the kidney cancer data. Cancer of the renal pelvis is usually transitional cell carcinoma (TCC), a distinctly different biologic entity than RCC. Transitional cell carcinomas are strongly associated with smoking and are discussed in the bladder and upper tract urothelial cancer chapter in this compendium. The impact of this data contamination is small, however, because of the low incidence of renal pelvis cancers and because renal pelvic tumor incidence has been relatively stable compared with incidence of RCC. In the analyses presented here, approximately 12% of kidney cancers are transitional cell carcinomas, histologically.

Prevalence

According to SEER data, as of January 1, 2001, 210,994 living individuals had ever been diagnosed with kidney cancer. As expected in this dataset, which reflects the racial proportions of the US population,

Table 12. Survival rates for kidney cancer, by race/ethnicity and gender, diagnosis year, and stage

	All			Whites			Blacks		
	Total	Males	Females	Total	Males	Females	Total	Males	Females
5-Yr Survival Rates									
Year of Diagnosis									
1960–1963[a]	…	…	…	37.0	36.0	39.0	38.0	38.0	37.0
1970–1973[a]	…	…	…	46.0	44.0	50.0	44.0	40.0	49.0
1974–1976[b]	51.6	51.0	52.6	51.7	50.9	52.9	49.2	50.2	47.4[d]
1977–1979[b]	51.0	51.2	50.8	51.0	51.5	50.2	51.8	44.7	60.9[d]
1980–1982[b]	51.7	52.1	51.1	51.1	51.9	49.8	56.3	53.8	60.2[d]
1982–1985[b]	55.7	56.5	54.3	55.8	56.8	54.2	55.0	54.1	56.4
1986–1988[b]	57.0	57.4	56.3	57.6	58.2	56.8	53.6	52.2	55.5
1988–1991[b]	60.1	60.7	59.2	60.8	61.9	59.2	58.1	55.1	62.3
1992–1994[b]	62.5	62.1	63.0	63.1	62.9	63.4	60.0	58.3	62.3
1995–2000[b]	63.9[c]	63.9[c]	63.9[c]	63.9[c]	64.1[c]	63.6[c]	63.5[c]	63.5[c]	63.5[c]
1995–2000[b]									
All Stages	63.9	63.9	63.9	63.9	64.1	63.6	63.5	63.5	63.5
Localized	91.1	91.4	90.6	91.7	91.7	91.8	87.7	89.7	85.5
Regional	59.1	60.7	56.4	58.9	60.8	55.8	58.7	61.9[d]	54.3[d]
Distant	9.3	9.3	9.2	3.1	9.2	8.7	9.2	8.4	9.9
Unstaged	32.7	35.0	30.1	33.3	38.3	26.9	21.2[d]	12.8[d]	33.6[e]

…data not available.

In this table, approximately 12% are renal pelvis cancers.

[a]Rates are based on End Results data from a series of hospital registries and one population-based registry.

[b]Rates are from the SEER 9 areas. The are based on data from population-based registries in Connecticut, New Mexico, Utah, Iowa, Hawaii, Atlanta, Detroit, Seattle-Puget Sound, and San Francisco-Oakland.

[c]The difference in rates between 1974–1976 and 1995–2000 is statistically significant ($p < 0.05$).

[d]The standard error of the survival rate is between 5 and 10 percentage points.

[e]The standard error of the survival rate is greater than 10 percentage points.

SOURCE: Surveillance, Epidemiology, and End Results (SEER) Program (www.seer.cancer.gov) 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.

the majority of the cases were seen in Caucasians (Table 9). Veterans Affairs (VA) data showed 186 cases of RCC per 100,000 VA patients in 2003 (Table 10). The prevalence of kidney cancer is likely to increase significantly over the next several years, partly because more low-stage disease is being detected, and therefore more patients are being cured and are living with the diagnosis of kidney cancer. Another reason, related to the incidence data, is the aging of the US population, which will lead to more diagnoses of kidney cancer with resultant increases in utilization of the healthcare system.

When considering the epidemiologic data, it is important to recognize the difference between mortality, the deaths in the general population due to the specific disease, and survival, which is limited to the patient cohort with the disease. The death rate from kidney cancer has been increasing slowly over the past 30 years, likely due to the increase in the incidence of the disease. In 2001, the overall death rate from kidney cancer was 4.3 per 100,000, compared with 3.6 per 100,000 in 1975 (Table 11). However, five- and ten-year survival rates have steadily increased over the past 25 years (Table 12), suggesting either that treatment is more effective or, more likely, that imaging has led to earlier diagnosis of kidney cancer, where surgical treatment is highly successful. SEER data indicate that advanced and metastatic cases have decreased, and this may account for the improvement seen in survival. However, the increase in mortality rates may be the result of the absolute increase in numbers of cases across all stages. SEER data indicate that most of the increase in incidence reflects the discovery of small, localized tumors (Figure 1). Five-

Table 13. Median survival rates from kidney cancer

	Patients (n)	Median Survival (months)	P-value
Sex			
Male	15,725	51	0
Female	9,268	55	
Stage			
Localized	11,679	142	0
Distant	13,314	13	
Age (yr)			
20–59	9,110	117	0
60+	15,883	36	
Race			
Black	2,024	47	0.03
White	22,969	53	
Localized stage			
Age 20–59			
Black	552	190	< 0.0001
White	4,251	259	
Age 60+			
Black	493	81	< 0.0001
White	6,383	101	
Advanced stage			
Black	450	11	< 0.0001
White	3,857	19	
Age 60+			
Black	529	6	< 0.0001
White	8,478	11	

In this table, approximately 12% are renal pelvis cancers.

SOURCE: Reprinted from Urology, 62, Vaishampayan UN, Do H, Hussain M, Schwartz K, Racial disparity in incidence patterns and outcome of kidney cancer, 1,012–1,017, Copyright 2003, with permission from Elsevier.

year survival increased from approximately 50% in 1980 to approximately 64% in 2000 (Table 12). For patients with localized disease, the five-year survival rate was approximately 90% in 1995–2000. Over the same period, the five-year survival rate for patients with regional disease was approximately 60%, and for those with metastatic disease, it was approximately 9%. Overall, survival rates improved slightly between 1992 and 2001. It appears that increasing survival rates over the past three decades reflect increasing diagnosis of curable tumors, as well as improved survival in Caucasians, who constitute most of the population in the dataset. After remaining flat in the mid 1990s (24) survival in African Americans began to increase at the end of the decade (Table 12).

The SEER incidence data also indicate racial disparity in overall survival. While mortality increased significantly from 1975 to 1990 in both African Americans and Caucasians, the mortality rate of African American men and women increased at more than twice the mortality rate of Caucasians (Table 11). When stratified by age and stage, the median survival for African Americans under 60 years of age with localized disease was 190 months, compared with 259 months for Caucasians in the same age range (Table 13). This difference, nearly six years, may be due to different biologic behavior of the disease between races, or it may be due to comorbid conditions that are more common in African Americans (13). Median survival also is significantly lower for African Americans over age 60 than for similarly aged Caucasians. A similar racial disparity is seen in advanced disease, with median survival of Caucasians being nearly double that of African Americans (Table 13). The survival difference between racial groups with metastatic disease again suggests different biological behavior, because treatments for metastatic disease (such as immunotherapy and chemotherapy) improve survival minimally, and therefore access to advanced medical care probably is not a factor. Again, the greater prevalence of comorbidities in African Americans (12) may play a role (Figure 4). While overall survival from kidney cancer has improved slightly across all racial groups, SEER data showed a modest decrease in survival in African American men and Asian/Pacific Islanders from 1992 to 2001. Because SEER data for RCC indicate overall rather than disease-specific survival, it is difficult to make conclusions about the biology of RCC in different racial groups. Overall survival renders these data susceptible to issues of racial disparities in comorbidities and access to healthcare.

TRENDS IN HEALTHCARE RESOURCE UTILIZATION

Inpatient Care

Most adult inpatient hospitalizations for kidney cancer are for surgery. Regardless of the technique used, surgery for kidney cancer always requires hospitalization for at least 24 hours. A small number of admissions are for complications from surgery, biopsy, embolization, immunotherapy, and chemotherapy; and supportive care in the late stages of disease for pain management, blood transfusions, and hydration.

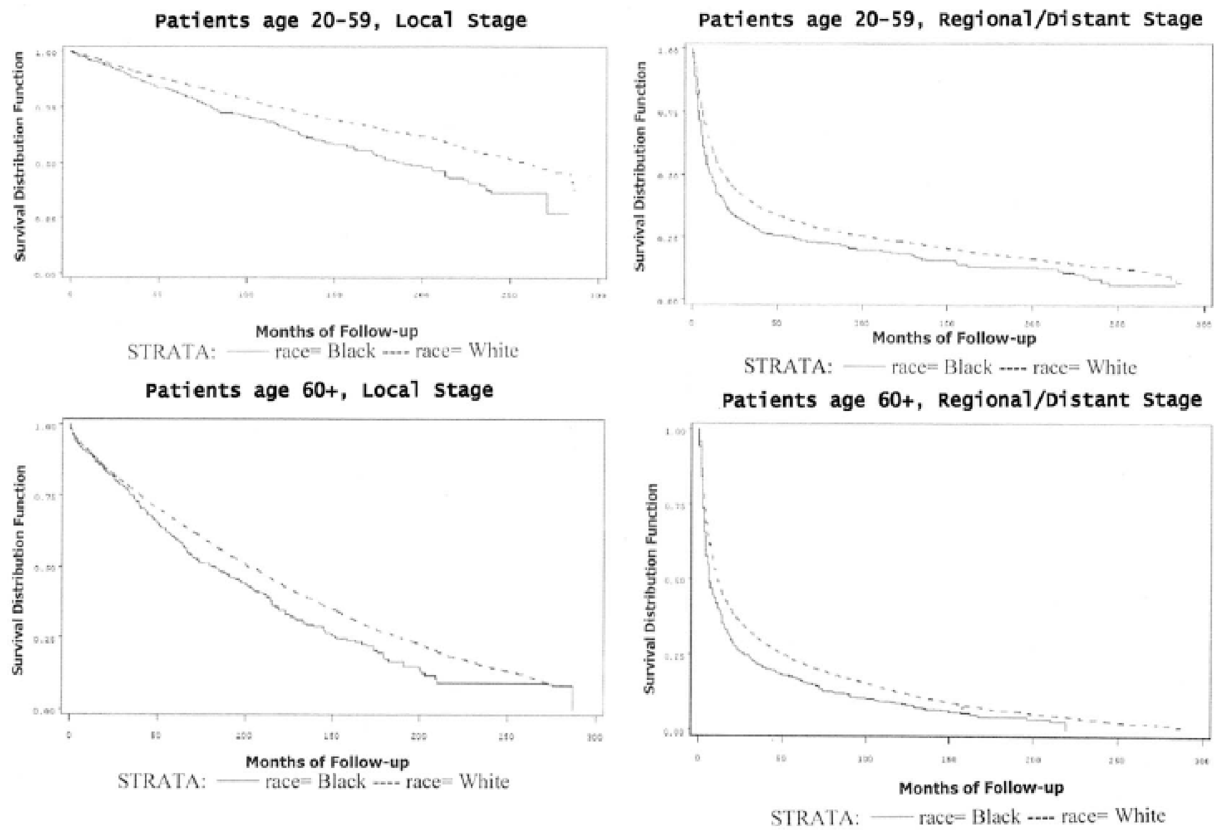

Figure 4. Survival rates from kidney cancer, by race.

SOURCE: Reprinted from Urology, 62, Vaishampayan UN, Do H, Hussain M, Schwartz K, Racial disparity in incidence patterns and outcome of kidney cancer, 1,012–1,017, Copyright 2003, with permission from Elsevier.

Three datasets were used for this analysis of inpatient hospitalizations: Medicare data from Centers for Medicare and Medicaid Services (CMS), the Healthcare Cost and Utilization Project (HCUP), and the National Association of Children's Hospitals and Related Institutions (NACHRI). NACHRI data differ significantly from CMS and HCUP data, because most pediatric kidney cancers are Wilms' tumors, which are frequently treated with inpatient chemotherapy.

CMS data from 1992, 1995, 1998, and 2001 show relatively stable numbers of inpatient hospitalizations for kidney cancer among Medicare beneficiaries, as might be expected from the SEER incidence data (Table 14). As of 2001, the age-adjusted rate of hospitalization for kidney cancer as the primary diagnosis was 25 per 100,000 Medicare beneficiaries. The rate for males was 33 per 100,000, and the rate for females was 18 per 100,000, reflecting the gender distribution of kidney cancer. Admission rates for Medicare beneficiaries were consistently higher in patients over 65 years of age and were highest for patients 65–69 and 75–79. The only age group in which a significant increase was seen over this time period was the 85- to 89-year-olds. This interesting finding raises the question of whether there is truly a higher incidence of RCC in patients aged 85–89, whether there are more healthy octogenarians needing treatment, or whether patients in this age group are being treated too aggressively.

The vast majority of patients in the databases are Caucasian. The numbers of admissions for Asian, Hispanic, and North American Natives are too small to interpret. The Northeast had the highest number of

Table 14. Inpatient stays by Medicare beneficiaries with kidney cancer listed as primary diagnosis, count[a], rate[b] (95% CI), age-adjusted rate[c]

	1992			1995			1998			2001		
	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate
Total[d]	8,500	24 (22–27)	24	8,520	24 (22–26)	24	8,040	24 (22–26)	24	8,680	25 (22–27)	25
Total < 65	660	12 (7.9–16)		580	9.5 (6.0–13)		660	11 (7.0–14)		660	9.4 (6.2–12)	
Total 65+	7,840	27 (24–29)		7,940	27 (24–30)		7,380	27 (24–30)		8,020	28 (26–31)	
Age												
65–69	2,600	29 (24–34)		2,060	24 (20–29)		1,840	25 (20–30)		2,400	32 (26–38)	
70–74	1,900	25 (20–30)		2,460	32 (26–37)		1,860	27 (21–32)		1,900	27 (22–33)	
75–79	1,920	33 (27–40)		1,920	34 (27–40)		1,800	32 (25–38)		1,900	32 (25–38)	
80–84	1,160	31 (23–38)		1,040	26 (19–33)		1,200	31 (23–39)		1,240	31 (23–38)	
85–89	160	7.8 (2.4–13)		340	16 (8.2–23)		480	22 (13–31)		480	21 (12–29)	
90–94	80	9.6 (0.2–19)		80	8.9 (0.2–18)		200	22 (8.4–36)		60	6.3 (0–13)	
95–97	20	11 (0–31)		20	11 (0–31)		0	0		40	20 (0–49)	
98+	0	0		20	11 (0–34)		0	0		0	0	
Race/ethnicity												
White	7,240	25 (22–27)	25	7,660	25 (23–28)	25	6,880	24 (22–27)	24	7,740	26 (23–28)	26
Black	680	23 (15–31)	22	560	17 (11–24)	19	720	23 (16–31)	22	620	18 (12–25)	18
Asian	…	…	…	20	12 (0–35)	0	20	6.4 (0–19)	6.4	20	4.2 (0–12)	4.2
Hispanic	…	…	…	100	25 (3.0–47)	20	160	23 (7.0–38)	23	20	2.5 (0–7.4)	2.5
N. American Native	…	…	…	0	0	0	0	0	0	20	30 (0–88)	30
Gender												
Male	5,160	35 (30–39)	35	4,980	33 (29–37)	33	5,020	35 (30–39)	36	4,980	32 (28–36)	33
Female	3,340	17 (14–19)	17	3,540	18 (15–20)	17	3,020	16 (13–18)	15	3,700	19 (16–21)	18
Region												
Midwest	1,900	22 (17–26)	22	1,860	21 (16–25)	21	2,040	24 (19–28)	24	2,280	26 (21–31)	26
Northeast	2,280	30 (24–35)	29	1,920	25 (20–30)	25	1,640	24 (19–30)	24	1,940	28 (22–34)	27
South	3,200	26 (22–30)	26	3,840	30 (26–34)	30	3,000	24 (20–28)	24	3,340	25 (21–29)	26
West	1,100	20 (15–25)	19	840	16 (11–21)	15	1,320	27 (20–33)	27	1,040	19 (14–24)	18

…data not available.

[a]Unweighted counts multiplied by 20 to arrive at values in the table.

[b]Rate per 100,000 Medicare beneficiaries in the same demographic stratum.

[c]Age-adjusted to the US Census-derived age distribution of the year under analysis.

[d]Persons of other races, unknown race and ethnicity, and other region are included in the totals.

NOTE: Counts less than 600 should be interpreted with caution.

SOURCE: Centers for Medicare and Medicaid Services, MedPAR Files, 1992, 1995, 1998, 2001.

Table 15. Inpatient hospital stays for kidney cancer listed as primary diagnosis, count, rate[a] (95% CI), age-adjusted rate[b]

	1994			1996			1998			2000		
	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate
Total[c]	23,006	19 (18–20)	19	24,528	19 (18–20)	19	26,069	20 (18–21)	20	30,045	22 (21–23)	22
Age												
35–44	1,445	3.6 (3.1–4.1)		1,630	3.8 (3.3–4.3)		1,823	4.1 (3.5–4.7)		1,986	4.5 (3.9–5.0)	
45–54	3,287	11 (10–13)		3,675	12 (10–13)		4,405	13 (12–14)		5,474	15 (14–16)	
55–64	5,243	26 (24–28)		5,832	28 (26–30)		6,114	28 (25–30)		7,187	31 (28–33)	
65–74	7,368	41 (39–44)		7,342	40 (37–43)		7,724	43 (40–46)		8,428	47 (44–51)	
75–84	4,675	48 (44–52)		5,054	48 (44–51)		5,011	44 (41–48)		5,732	49 (45–53)	
85+	989	36 (29–42)		995	36 (30–41)		991	34 (29–40)		1,239	40 (34–45)	
Race/ethnicity												
White	15,423	16 (15–17)	16	16,356	16 (15–17)	16	16,713	16 (15–18)	16	18,536	18 (17–19)	17
Black	1,561	13 (11–15)	14	1,657	13 (11–14)	14	1,817	13 (11–15)	15	2,002	14 (12–16)	15
Hispanic	710	8.6 (7.0–10)	11	893	9.6 (7.6–11)	12	1,142	11 (8.9–13)	14	1,418	12 (11–14)	15
Gender												
Male	13,872	25 (23–26)	26	14,828	25 (23–26)	26	15,587	25 (23–27)	26	18,217	28 (26–30)	29
Female	9,134	14 (14–15)	14	9,700	14 (13–15)	14	10,483	15 (14–16)	14	11,818	16 (15–17)	16
Region												
Midwest	5,885	21 (19–23)	21	6,277	21 (18–23)	21	6,260	20 (18–22)	20	7,469	24 (21–27)	24
Northeast	5,206	20 (18–23)	20	5,709	22 (19–25)	22	6,256	24 (18–29)	23	6,627	24 (21–28)	24
South	8,273	20 (19–22)	20	8,727	20 (18–21)	19	9,550	20 (19–22)	20	10,758	22 (20–24)	22
West	3,643	14 (13–16)	15	3,814	14 (13–16)	15	4,004	14 (12–16)	15	5,191	18 (15–20)	18
MSA												
Rural	3,318	10 (8.9–12)	9.7	3,048	10 (8.9–11)	9.6	2,807	9.0 (7.6–10)	8.6	3,042	9.6 (8.4–11)	9.0
Urban	19,648	22 (21–24)	23	21,451	22 (21–23)	22	23,170	23 (21–24)	23	26,954	26 (24–27)	26

MSA, metropolitan statistical area.

[a]Rate per 100,000 is based on 1994, 1996, 1998, 2000 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US civilian non-institutionalized population, 35 years and older.

[b]Age-adjusted to the US Census-derived age distribution of the year under analysis.

[c]Persons of other races, missing or unavailable race and ethnicity, and missing MSA are included in the totals.

NOTE: Counts may not sum to totals due to rounding.

SOURCE: Healthcare Cost and Utilization Project Nationwide Inpatient Sample, 1994, 1996, 1998, 2000.

Table 16.Trends in mean inpatient length of stay (LOS) in days and cost per child admitted with malignant neoplasm of kidney[a] listed as primary or any diagnosis, 1999–2003

	Count	Percent	LOS	Mean Cost
Primary diagnosis				
Total	2,011		8.5	$22,890
Age				
0–2	802	40%	8.2	$21,112
3–10	1,070	53%	8.5	$22,986
11–17	120	6%	9.5	$29,888
18+	19	1%	13.6	$48,338
Race/ethnicity				
White	1,240	62%	8.2	$22,106
Black	330	16%	8.4	$23,167
Asian	17	1%	10.2	$22,697
Hispanic	206	10%	10.5	$28,092
N. American Native	13	1%	15.1	$38,981
Missing	82	4%	6.8	$15,951
Other	123	6%	9.0	$24,294
Gender				
Female	1,059	53%	8.3	$22,460
Male	952	47%	8.7	$23,369
Region				
Midwest	618	31%	8.5	$23,064
Northeast	234	12%	7.7	$20,145
South	795	40%	8.5	$23,579
West	364	18%	9.2	$22,853
Any diagnosis				
Total	6,289		5.8	$14,186
Age				
0–2	2,085	33%	5.8	$13,298
3–10	3,591	57%	5.6	$13,456
11–17	530	8%	6.4	$21,068
18+	83	1%	8.6	$24,126
Race/ethnicity				
White	3,848	61%	5.6	$13,675
Black	1,116	18%	5.9	$14,700
Asian	33	1%	6.9	$15,100
Hispanic	789	13%	6.5	$16,230
N. American Native	21	0%	11.6	$28,059
Missing	188	3%	5.4	$11,239
Other	294	5%	6.1	$14,236
Gender				
Female	3,215	51%	5.8	$14,352
Male	3,074	49%	5.8	$14,013
Region				
Midwest	1,696	27%	5.9	$14,522
Northeast	679	11%	5.5	$12,723
South	2,826	45%	5.4	$13,628
West	1,088	17%	6.7	$15,981

[a]Using ICD-9 codes 189.0 (malignant neoplasm of kidney, except pelvis) and 189.8 (malignant neoplasm of other specified sites of urinary organs).

SOURCE: National Association of Children's Hospitals and Related Institutions, 1999–2003.

admissions, but the age-adjusted rates of admission did not vary significantly between regions over the years examined.

HCUP data from 1994, 1996, 1998, and 2000 indicate that admissions for kidney cancer as the primary diagnosis increased slightly, from 19 per 100,000 in 1994 to 22 per 100,000 in 2000 (Table 15). The highest rate of admissions was in the 75–84 age group. As in the CMS dataset, the gender distribution of kidney cancer is reflected in the HCUP data, with stable rates of admission for men that are nearly double the rates for women. The rate of admission of Caucasians and African Americans was stable, but admissions of Hispanics saw a 1.5-fold increase. It must be noted that these numbers are small and should be viewed with caution. Rates of admission did not change in different geographic regions, but the West had significantly lower rates of admission than did the Northeast, South, and Midwest. Admissions in urban areas were much more common than in non-urban areas, and they increased significantly between 1994 and 2000. While this may indicate a trend in patient migration, it more likely reflects better access to screening and treatment and more resources in urban areas.

The primary kidney cancers in children are Wilms' tumors and neuroblastomas, which are treated with multimodality therapy. Admissions for pediatric kidney cancer may be for many reasons other than surgery, including biopsy for diagnosis and staging, surgery for port placement for chemotherapy, chemotherapy treatments, complications of chemotherapy treatments, and radiation. Pooled NACHRI data from 1999–2003 (Table 16) show a total of 2,011 admissions for kidney cancer as the primary diagnosis, with an average inpatient length of stay of 8.5 days. When the database was queried for kidney cancer as any diagnosis, 6,289 admissions were captured, with an average length of stay of 5.8 days. The majority of children affected were between three and ten years of age, and length of stay increased with increasing age. Admissions for males and females were nearly equal. Over 60% of the admitted patients were Caucasian; nearly 20% were African American; and 10% were Hispanic. The majority of admissions occurred in the South and Midwest.

Outpatient Care

Outpatient care for patients with kidney cancer includes initial visits for symptoms such as flank or abdominal pain or hematuria, subsequent evaluation (which includes radiologic evaluation of the kidneys and ureters and cystoscopic evaluation of the bladder), discussion of the diagnosis, staging, and follow-up after surgery (called *surveillance*).

Physician Office Visits

In the Medicare data, the rate of total physician office visits for kidney cancer as the primary diagnosis increased 29% from 1992 to 2001 (Table 17). Visits for patients under 65 years of age remained stable over this period but peaked in 1995, while visits for patients over 65 increased 35%. This reflects the increased incidence of kidney cancer in the more commonly affected age group. Physician office visit rates varied within regions, but the highest rates were seen in the Northeast in 1998 and 2001. Regional differences in utilization of outpatient resources are difficult to explain because regional incidence data are not available. The disparities may result from differences in practice patterns for the outpatient care delivered for patients with RCC. Visit rates increased significantly for both men and women from 1992 to 2001, but the 2:1 preponderance of disease in men versus women was stable. The rate of visits by Caucasians increased 32% from 1992 to 2001, but rates for African Americans and Hispanics were stable. However, the number of African American and Hispanic patients is small, and the data should be interpreted with caution.

Data from the National Ambulatory Medical Care Survey (NAMCS) for even years from 1992 to 2000 were pooled because of the small numbers of kidney cancer patients and are therefore less informative than the Medicare data (Table 18). NAMCS data indicate more than 1.2 million physician office visits for kidney cancer as the primary diagnosis during these years, an average annualized rate of 195 visits per 100,000 population. The majority of these patients were over 65, Caucasian, and male, and most were seen in urban metropolitan areas. Trends in utilization, as well as age, race, and gender variation, could not be evaluated because of the small number of cases.

Table 17. Physician office visits by Medicare beneficiaries with kidney cancer listed as primary diagnosis, count[a], rate[b] (95% CI), age-adjusted rate[c]

	1992				1995				1998				2001			
	Count		Rate	Age-Adjusted Rate	Count		Rate	Age-Adjusted Rate	Count		Rate	Age-Adjusted Rate	Count		Rate	Age-Adjusted Rate
Total[d]	89,280	256	(248–263)	256	106,120	300	(292–308)	300	102,540	306	(297–314)	306	115,940	329	(320–337)	329
Total < 65	8,760	158	(143–173)		11,740	191	(176–207)		6,540	105	(94–117)		11,200	159	(146–172)	
Total 65+	80,520	274	(266–283)		94,380	322	(313–332)		96,000	351	(341–361)		104,740	371	(361–381)	
Age																
65–69	26,760	297	(281–313)		33,260	393	(374–412)		25,320	346	(327–365)		26,040	346	(327–365)	
70–74	27,720	36	(346–384)		26,540	343	(325–362)		30,240	432	(410–454)		27,140	390	(369–411)	
75–79	15,960	278	(259–297)		22,460	394	(371–417)		22,540	398	(375–421)		26,260	439	(416–463)	
80–84	7,260	191	(172–211)		9,100	230	(209–252)		13,320	347	(320–373)		16,820	414	(386–442)	
85–89	2,200	107	(87–127)		2,440	112	(92–132)		4,060	186	(160–211)		7,360	316	(284–348)	
90–94	600	72	(46–98)		520	58	(36–80)		520	57	(35–79)		980	103	(74–131)	
95–97	20	11	(0–31)		20	11	(0–31)		0	0			140	72	(18–125)	
98+	0	0			40	23	(0–54)		0	0			0	0		
Race/ethnicity																
White	78,580	266	(258–274)	265	93,300	307	(299–316)	306	91,260	321	(312–331)	323	104,580	349	(340–359)	349
Black	5,620	190	(167–212)	188	8,240	256	(231–280)	276	6,300	203	(181–226)	188	5,880	172	(153–192)	171
Asian	…	...		…	140	84	(22–146)	48	260	83	(38–128)	89	620	131	(85–176)	131
Hispanic	…	...		…	3,000	751	(631–871)	731	2,560	364	(301–427)	350	1,580	199	(155–243)	159
N. American Native	…	...		…	60	165	(0–353)	165	20	37	(0–109)	37	180	270	(94–445)	270
Gender																
Male	56,780	381	(367–395)	389	60,320	396	(382–410)	401	67,200	464	(448–480)	469	74,140	481	(465–496)	476
Female	32,500	162	(154–170)	157	45,800	227	(218–236)	224	35,340	185	(177–194)	181	41,800	211	(202–220)	214
Region																
Midwest	22,600	259	(244–274)	265	31,700	352	(335–369)	360	22,880	265	(250–280)	269	28,020	319	(302–335)	332
Northeast	18,920	246	(230–261)	246	22,140	289	(272–305)	281	24,380	364	(344–384)	358	27,720	401	(380–422)	374
South	33,240	272	(259–285)	271	36,540	287	(274–301)	283	42,340	342	(327–356)	344	45,760	345	(331–359)	357
West	10,260	187	(171–204)	182	12,520	242	(223–261)	249	12,380	250	(230–270)	247	14,020	260	(240–279)	245

…data not available.

[a]Unweighted counts multiplied by 20 to arrive at values in the table.

[b]Rate per 100,000 Medicare beneficiaries in the same demographic stratum.

[c]Age-adjusted to the US Census-derived age distribution of the year under analysis.

[d]Persons of other races, unknown race and ethnicity, and other region are included in the totals.

NOTE: Counts less than 600 should be interpreted with caution.

SOURCE: Centers for Medicare and Medicaid Services, 5% Carrier and Outpatient Files, 1992, 1995, 1998, 2001.

Table 18. Physician office visits for kidney cancer listed as any diagnosis, 1992–2000 (merged), count, rate[a] (95% CI), annualized rate[b], age-adjusted rate[c]

	1992–2000				
	Count	5- Year Rate		Annualized Rate	5-Year Age-Adjusted Rate
Total[d]	1,236,274	974	(600–1,349)	195	971
Age					
35–64	*	*		*	
65+	670,913	2,134	(1,125–3,143)	427	
Race/ethnicity					
White	922,937	924	(543–1,305)	185	893
Other	*	*		*	*
Gender					
Male	741,161	1,242	(607–1,878)	248	1,293
Female	*	*		*	*
MSA					
MSA	1,028,012	1,078	(638–1,512)	215	1,063
Non-MSA	*	*		*	*

*Figure does not meet standard for reliability or precision.

MSA, metropolitan statistical area.

[a]Rate per 100,000 is based on 1992, 1994, 1996, 1998, 2000 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US civilian non-institutionalized population, 35 years and older.

[b]Age-adjusted to the US Census-derived age distribution of the midpoint of years.

[c]Average annualized rate per year.

[d]Persons of missing or unavailable race and ethnicity, and missing MSA are included in the total.

NOTE: Counts may not sum to total due to rounding.

SOURCE: National Ambulatory Medical Care Survey, 1992, 1994, 1996, 1998, 2000.

Hospital Outpatient Care

Medicare data from 1992, 1995, 1998, and 2001 showed a significant increase in hospital outpatient visits for kidney cancer as the primary diagnosis from 1992 to 1995; this increase was sustained in 1998 but was followed by a decrease in 2001 (Table 19). As was seen in the Medicare data on physician office visits, the rate of hospital outpatient visits was stable for patients under 65 (a decrease was seen in 2001), while a significant increase was seen in those over 65. However, fewer patients were seen in this setting than in physicians' offices. Again, approximately twice as many visits were made by men than by women. The 75- to 79-year age group had the highest rate of hospital outpatient visits in 1992 and 1995, and the 65- to 69-year age group had the highest rate in 1998 and 2001. The Midwest had high rates of outpatient visits from 1992 to 1998, and in 1995, these rates were three times the rates in other regions. A significant increase in visits occurred in the Northeast from 1992 to 2001.

Ambulatory Surgery

Ambulatory surgery visits for kidney cancer are uncommon, as most surgical interventions require inpatient hospitalization (Tables 20 and 21). Medicare data from 1992, 1995, 1998, and 2001 showed a slight increase in the use of the ambulatory setting, to 4.9 per 100,000 Medicare beneficiaries in 2001 (Table 20). But because the counts are low, meaningful information cannot be gleaned from the data. Similarly, the pooled data from the National Survey of Ambulatory Surgery from 1994 to 1996 do not allow for meaningful interpretation (Table 21). The available data indicate that the ambulatory surgery setting is not an important contributor to the utilization of medical services for kidney cancer.

Emergency Room Care

Emergency room visits for a primary diagnosis of kidney cancer are rare, according to Medicare data (Table 22). Such visits may occur for acute events such as bleeding or surgical complications or for chronic problems such as failure to thrive, but the datasets

Table 19. Hospital outpatient visits by Medicare beneficiaries with kidney cancer listed as primary diagnosis, count[a], rate[b] (95% CI), age-adjusted rate[c]

	1992			1995			1998			2001		
	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate
Total[d]	11,540	33 (30–36)	33	15,020	42 (39–45)	42	14,100	42 (39–45)	42	13,380	38 (35–41)	38
Total < 65	1,620	29 (23–36)		1,240	20 (15–25)		1,820	29 (23–35)		1,200	17 (13–21)	
Total 65+	9,920	34 (31–37)		13,780	47 (44–51)		12,280	45 (41–49)		12,180	43 (40–47)	
Age												
65–69	3,980	44 (38–50)		4,540	54 (47–61)		4,220	58 (50–65)		4,100	54 (47–62)	
70–74	2,260	30 (24–35)		2,620	34 (28–40)		3,640	52 (44–60)		3,580	51 (44–59)	
75–79	2,700	47 (39–55)		4,980	87 (77–98)		2,180	39 (31–46)		2,640	44 (37–52)	
80–84	420	11 (6.3–16)		1,240	31 (24–39)		1,640	43 (33–52)		1,080	27 (19–34)	
85–89	540	26 (16–36)		300	14 (6.8–21)		560	26 (16–35)		520	22 (14–31)	
90–94	0	0		80	8.9 (0.2–18)		20	2.2 (0–6.5)		240	25 (11–39)	
95–97	0	0		20	11 (0–31)		20	9.9 (0–29)		20	10 (0–30)	
98+	20	13 (0–39)		0	0		0	0		0	0	
Race/ethnicity												
White	9,780	33 (30–36)	33	12,920	43 (39–46)	42	11,340	40 (37–43)	40	10,600	35 (32–38)	35
Black	1,300	44 (33–55)	46	1,700	53 (42–64)	53	1,500	48 (37–59)	47	840	25 (17–32)	24
Asian	…	...	…	0	0	0	140	45 (11–78)	38	220	46 (19–74)	34
Hispanic	…	...	…	200	50 (19–81)	45	260	37 (17–57)	37	140	18 (4.5–31)	15
N. American Native	…	...	…	0	0	0	140	259 (67–452)	222	160	240 (73–406)	210
Gender												
Male	8,520	57 (52–63)	59	9,780	64 (59–70)	62	8,040	56 (50–61)	54	8,660	56 (51–61)	56
Female	3,020	15 (13–17)	14	5,240	26 (23–29)	28	6,060	32 (28–35)	33	4,720	24 (21–27)	24
Region												
Midwest	3,940	45 (39–51)	43	8,220	91 (82–100)	89	5,380	62 (55–70)	61	3,920	45 (38–51)	44
Northeast	2,580	33 (28–39)	29	2,240	29 (24–35)	30	2,820	42 (35–49)	44	3,680	53 (46–61)	52
South	3,760	31 (26–35)	35	2,640	21 (17–24)	21	3,420	28 (23–32)	28	3,240	24 (21–28)	26
West	1,260	23 (17–29)	23	1,900	37 (29–44)	39	2,460	50 (41–58)	48	2,520	47 (39–55)	45

…data not available.

[a]Unweighted counts multiplied by 20 to arrive at values in the table.

[b]Rate per 100,000 Medicare beneficiaries in the same demographic stratum.

[c]Age-adjusted to the US Census-derived age distribution of the year under analysis.

[d]Persons of other races, unknown race and ethnicity, and other region are included in the totals.

NOTE: Counts less than 600 should be interpreted with caution.

SOURCE: Centers for Medicare and Medicaid Services, 5% Carrier and Outpatient Files, 1992, 1995, 1998, 2001.

Table 20. Ambulatory surgery visits by Medicare beneficiaries with kidney cancer listed as primary diagnosis, count[a], rate[b] (95% CI), age-adjusted rate[c]

	1992			1995			1998			2001		
	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate
Total[d]	1,060	3.0 (2.2–3.9)	3.0	1,100	3.1 (2.3–3.9)	3.1	1,420	4.2 (3.3–5.2)	4.2	1,720	4.9 (3.8–5.9)	4.9
Total < 65	20	0.4 (0–1.1)		120	2.0 (0.4–3.5)		140	2.3 (0.6–3.9)		120	1.7 (0.3–3.1)	
Total 65+	1,040	3.5 (2.6–4.5)		980	3.3 (2.4–4.3)		1,280	2.4 (3.5–5.8)		1,600	5.7 (4.4–6.9)	
Age												
65–69	320	3.5 (1.8–5.3)		240	2.8 (1.2–4.4)		360	4.9 (2.6–7.2)		340	4.5 (2.4–6.7)	
70–74	480	6.3 (3.8–8.9)		380	4.9 (2.7–7.1)		420	6.0 (3.4–8.6)		340	4.9 (2.6–7.2)	
75–79	140	2.4 (0.6–4.3)		240	4.2 (1.8–6.6)		280	4.9 (2.3–7.5)		680	11 (7.5–15.2)	
80–84	100	2.3 (0.3–5.0)		60	1.5 (0–3.2)		140	3.6 (0.9–6.3)		220	5.4 (2.2–8.6)	
85+	0	0		60	2.8 (0–5.9)		60	2.7 (0–5.9)		20	0.9 (0–2.5)	
Race/ethnicity												
White	900	3.0 (2.2–3.9)	2.9	1,060	3.5 (2.6–4.4)	3.5	1,300	4.6 (3.5–5.7)	4.6	1,600	5.3 (4.2–6.5)	5.3
Black	20	0.7 (0–2.0)	0.7	0	0	0	40	1.3 (0–3.1)	1.3	120	3.5 (0.7–6.3)	3.5
Asian	…	...	…	0	0	0	0	0	0	0	0	0
Hispanic	…	...	…	20	5.0 (0–15)	5.0	0	0	0	0	0	0
N. American Native	…	...	…	0	0	0	0	0	0	0	0	0
Gender												
Male	600	4.0 (2.6–5.5)	4.0	700	4.6 (3.1–6.1)	4.7	920	6.4 (4.5–8.2)	6.5	1,180	7.7 (5.7–9.6)	7.9
Female	460	2.3 (1.4–3.2)	2.1	400	2.0 (1.1–2.8)	1.9	500	2.6 (1.6–3.7)	2.5	540	2.7 (1.7–3.7)	2.4
Region												
Midwest	180	2.1 (0.7–3.4)	1.8	400	4.4 (2.5–6.4)	4.2	580	6.7 (4.3–9.2)	7.2	480	5.5 (3.3–7.6)	5.2
Northeast	240	3.1 (1.4–4.9)	3.1	260	3.4 (1.6–5.2)	3.4	180	2.7 (0.9–4.4)	2.1	380	5.5 (3.0–8.0)	5.5
South	500	4.1 (2.5–5.7)	4.3	360	2.8 (1.5–4.1)	2.8	500	4.0 (2.5–5.6)	4.0	760	5.7 (3.9–7.6)	5.7
West	100	1.8 (0.2–3.4)	1.8	80	1.5 (0–3.0)	1.9	140	2.8 (0.7–4.9)	2.0	80	1.5 (0–2.9)	1.5

…data not available.
[a]Unweighted counts multiplied by 20 to arrive at values in the table.
[b]Rate per 100,000 Medicare beneficiaries in the same demographic stratum.
[c]Age-adjusted to the US Census-derived age distribution of the year under analysis.
[d]Persons of other races, unknown race and ethnicity, and other region are included in the totals.
NOTE: Counts less than 600 should be interpreted with caution.
SOURCE: Centers for Medicare and Medicaid Services, 5% Carrier and Outpatient Files, 1992, 1995, 1998, 2001.

Table 21. Ambulatory surgery visits for kidney cancer listed as any diagnosis, 1994–1996 (merged), count, rate[a] (95% CI), age-adjusted rate[b]

	1994–1996		
	Count	3-Year Rate	3-Year Age-Adjusted Rate
Total	12,897	10 (5.2–16)	10

[a]Rate per 100,000 is based on 1994, 1995, 1996 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporation, for relevant demographic categories of US civilian non-institutionalized population, 35 years and older.

[b]Age-adjusted to the US Census-derived age distribution of the midpoint of years.

SOURCE: National Survey of Ambulatory Surgery, 1994, 1995, 1996.

may not capture these events because the primary diagnosis may not be listed as renal cell carcinoma. Nearly all the counts of emergency room visits for kidney cancer in the Medicare dataset are below 600, which limits definitive interpretation. Regardless, utilization of the emergency room does not contribute substantially to the burden of treatment of kidney cancer in the United States.

Surgical Trends

Traditionally, the presence of a kidney tumor mandated removal of the entire kidney, but surgical techniques have evolved significantly over the past several years. Introduced more than 50 years ago, partial nephrectomy was initially not widely accepted for the treatment of kidney cancer due to concerns of leaving behind residual tumor or small satellite lesions and because of the technical difficulty of the procedure. With improvements in imaging, however, great detail is now available for the surgical planning of partial nephrectomy, including information about the depth of penetration of the tumor into the kidney and its blood supply. Studies of the oncologic efficacy of the procedure, when feasible, have shown that it is as effective as radical nephrectomy, even with a very small margin of normal kidney around the tumor (28). Currently, partial nephrectomy is indicated for tumors less than 4 cm in size, even when the uninvolved kidney is normal, despite the fact that patients can lead essentially normal lives with a solitary kidney. It is reasonable to consider partial nephrectomy to preserve as much functioning kidney as possible in patients who have the potential to develop other diseases that impair renal function later in life, such as diabetes and hypertension. The incidence of chronic renal insufficiency is somewhat higher after radical than after partial nephrectomy (29).

Despite the increasing evidence favoring partial nephrectomy for small tumors, current data do not yet reflect widespread adoption of this practice. However, there has been a small increase in utilization of partial nephrectomy (Table 23). In contrast, CMS (Table 24) data do not show a significant increase in this trend, perhaps because of the smaller number of cases captured in the CMS datasets or because of patient characteristics, advanced age and increased comorbidities, favoring radical nephrectomy in the CMS populations. As expected, the increasing use of partial nephrectomy closely parallels the increase in the rate of diagnosis of kidney cancer, since most of the new incident cases are small tumors that are amenable to partial nephrectomy. Open radical nephrectomy remains the most common surgical approach in the management of kidney cancer (Table 25); however, its use has declined significantly since 1992.

Laparoscopic surgery for kidney cancer has been increasingly adopted since initial reports on the technique in the mid 1990s (30). The major advantages of this technique over traditional open surgery are shorter hospitalization, decreased pain, and earlier return to work and normal activity. The increasing utilization of laparoscopy is difficult to assess in current datasets, because data from the recent past are not publically available yet. However, this trend is becoming apparent with the appearance of both laparoscopic radical nephrectomy and laparoscopic partial nephrectomy in the VA dataset in the early 2000s. Laparoscopic partial nephrectomy first appear in 2001 data; no cases were captured before then (Table 26). In both academic (31) and community (32) settings, laparoscopic techniques are increasingly viewed as the standard of care in the treatment of patients with kidney cancer.

Even more recently, the use of laparoscopic partial nephrectomy is increasing as urologists attempt to replicate the oncologic principles employed in traditional surgery, wherein partial nephrectomy should be performed for small tumors whenever feasible. Advances in instrumentation and materials used for control of bleeding have facilitated the

Table 22. Emergency room visits by Medicare beneficiaries with kidney cancer listed as primary diagnosis, count[a], rate[b] (95% CI), age-adjusted rate[c]

	1992			1995			1998			2001		
	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate	Count	Rate	Age-Adjusted Rate
Total[d]	660	1.9 (1.2–2.5)	1.9	340	1.0 (0.5–1.4)	1.0	720	2.1 (1.4–2.8)	2.1	240	0.7 (0.3–1.1)	0.7
Total < 65	40	0.7 (0–1.7)		80	1.3 (0–2.6)		40	0.6 (0–1.5)		20	0.3 (0–0.8)	
Total 65+	620	2.1 (1.4–2.9)		260	0.9 (0.4–1.4)		680	2.5 (1.7–3.3)		220	0.8 (0.3–1.2)	
Age												
65–69	260	2.9 (1.3–4.4)		60	0.7 (0–1.5)		260	3.5 (1.6–5.5)		60	0.8 (0–1.7)	
70–74	160	2.1 (0.6–3.6)		100	1.3 (0.2–2.4)		240	3.4 (1.5–5.4)		100	1.4 (0.2–2.7)	
75–79	100	1.7 (0.2–3.3)		40	0.7 (0–1.7)		160	2.8 (0.9–4.8)		40	0.7 (0–1.6)	
80–84	60	1.6 (0–3.4)		40	1.0 (0–2.4)		20	0.5 (0–1.5)		0	0	
85+	40	1.9 (0–4.6)		20	2.2 (0–6.6)		0	0		20	0.9 (0–2.5)	
Race/ethnicity												
White	420	1.4 (0.8–2.0)	1.3	260	0.9 (0.4–1.3)	0.9	620	2.2 (1.4–3.0)	2.2	160	0.5 (0.2–0.9)	0.5
Black	220	7.4 (3.0–12)	9.4	80	2.5 (0.1–4.9)	1.9	80	2.6 (0.1–5.1)	2.6	60	1.8 (0–3.8)	1.8
Asian	…	...	…	0	0	0	0	0	0	0	0	0
Hispanic	…	...	…	0	0	0	20	2.8 (0–8.4)	2.8	20	2.5 (0–7.4)	0
N. American Native	…	...	…	0	0	0	0	0	0	0	0	0
Gender												
Male	480	3.2 (1.9–4.5)	3.2	140	0.9 (0.2–1.6)	0.9	400	2.8 (1.6–4.0)	2.9	200	1.3 (0.5–2.1)	1.2
Female	180	0.9 (0.3–1.5)	0.8	200	1.0 (0.4–1.6)	1.0	320	1.7 (0.9–2.5)	1.6	40	0.2 (0–0.5)	0.2
Region												
Midwest	160	1.8 (0.6–3.1)	1.4	120	1.3 (0.3–2.4)	1.1	300	3.5 (1.7–5.2)	3.7	60	0.7 (0–1.5)	0.7
Northeast	120	1.6 (0.3–2.8)	1.3	80	1.0 (0–2.1)	1.0	40	0.6 (0–1.4)	0.6	40	0.6 (0–1.4)	0.6
South	140	1.1 (0.3–2.0)	1.0	60	0.5 (0–1.0)	0.5	220	1.8 (0.7–2.8)	1.8	100	0.8 (0.1–1.4)	0.6
West	240	4.4 (1.9–6.9)	5.1	80	1.5 (0–3.0)	1.5	160	3.2 (1.0–5.5)	2.8	40	0.7 (0–1.8)	0.7

…data not available.

[a]Unweighted counts multiplied by 20 to arrive at values in the table.

[b]Rate per 100,000 Medicare beneficiaries in the same demographic stratum.

[c]Age-adjusted to the US Census-derived age distribution of the year under analysis.

[d]Persons of other races, unknown race and ethnicity, and other region are included in the totals.

NOTE: Counts less than 600 should be interpreted with caution.

SOURCE: Centers for Medicare and Medicaid Services, 5% Carrier and Outpatient Files, 1992, 1995, 1998, 2001.

Table 23. Inpatient hospital stays for kidney cancer listed as primary diagnosis with partial nephrectomy performed, count, rate[a] (95% CI), rate per visits[b] (95% CI)

	1994				1996			
	Count	Rate per 100,000 population[a]	Rate per 100,000 visits for primary diagnosis of Kidney Cancer[b]		Count	Rate per 100,000 population[a]	Rate per 100,000 visits for primary diagnosis of Kidney Cancer[b]	
Total[c]	1,063	0.9 (0.8–1.0)	4,621	(4,169–5,073)	1,446	1.1 (1.0–1.2)	5,895	(5,398–6,393)
Age								
35–44	*	*	*		*	*	*	
45–54	*	*	*		199	0.6 (0.4–0.8)	811	(583–1,044)
55–64	238	1.2 (1.0–1.4)	1,035	(848–1,217)	403	1.9 (1.7–2.2)	1,643	(1,419–1,867)
65–74	406	2.3 (2.0–2.6)	1,765	(1,543–1,982)	418	2.3 (2.0–2.6)	1,704	(1,500–1,908)
75–84	215	2.2 (1.9–2.6)	935	(800–1,074)	280	2.6 (2.3–3.0)	1,142	(995–1,288)
85+	*	*	*		*	*	*	
Gender								
Male	742	1.3 (1.2–1.5)	3,225	(2,908–3,543)	938	1.6 (1.4–1.7)	3,824	(3,547–4,101)
Female	322	0.5 (0.4–0.6)	1,400	(1,134–1,660)	508	0.8 (0.6–0.9)	2,071	(1,700–2,442)
Race/ethnicity								
White	722	0.8 (0.7–0.8)	3,138	(2,804–3,477)	962	1.0 (0.9–1.0)	3,922	(3,543–4,305)
Black	*	*	*		*	*	*	
Hispanic	*	*	*		*	*	*	
Region								
Midwest	219	0.8 (0.6–1.0)	952	(682–1,226)	390	1.3 (1.0–1.6)	1,590	(1,239–1,937)
Northeast	255	1.0 (0.8–1.2)	1,108	(882–1,334)	311	1.2 (1.0–1.4)	1,268	(1,076–1,460)
South	443	1.1 (1.0–1.2)	1,926	(1,708–2,139)	586	1.3 (1.2–1.4)	2,389	(2,149–2,630)
West	*	*	*		160	0.6 (0.5–0.7)	652	(510–795)
MSA								
Rural	*	*	*		*	*	*	
Urban	929	1.1 (0.9–1.2)	4,038	(3,595–4,477)	1,378	1.4 (1.3–1.5)	5,618	(5,141–6,095)

Continued on next page

Table 23 (continued). Inpatient hospital stays for kidney cancer listed as primary diagnosis with partial nephrectomy performed, count, rate[a] (95% CI), rate per visits[b] (95% CI)

	1998			2000		
	Count	Rate per 100,000 population[a]	Rate per 100,000 visits for primary diagnosis of Kidney Cancer[b]	Count	Rate per 100,000 population[a]	Rate per 100,000 visits for primary diagnosis of Kidney Cancer[b]
Total[c]	1,585	1.2 (1.1–1.3)	6,080 (5,585–6,579)	2,421	1.8 (1.7–1.9)	8,058 (7,625–8,494)
Age						
35–44	158	0.4 (0.3–0.5)	606 (437–771)	162	0.4 (0.3–0.4)	539 (409–669)
45–54	306	0.9 (0.7–1.1)	1,174 (963–1,385)	456	1.2 (1.1–1.4)	1,518 (1,311–1,727)
55–64	419	1.9 (1.6–2.2)	1,607 (1,346–1,868)	658	2.8 (2.5–3.1)	2,190 (1,954–2,426)
65–74	485	2.7 (2.4–3.0)	1,860 (1,638–2,087)	790	4.4 (4.1–4.8)	2,629 (2,406–2,849)
75–84	202	1.8 (1.5–2.1)	775 (637–917)	312	2.7 (2.3–3.1)	1,038 (882–1,195)
85+	*	*	*	*	*	*
Gender						
Male	1,072	1.7 (1.6–1.8)	4,112 (3,775–4,450)	1,564	2.4 (2.3–2.6)	5,206 (4,883–5,528)
Female	513	0.7 (0.6–0.8)	1,968 (1,661–2,279)	857	1.2 (1.1–1.3)	2,852 (2,566–3,139)
Race/ethnicity						
White	1,033	1.0 (0.9–1.1)	3,963 (3,541–4,388)	1,443	1.4 (1.3–1.5)	4,803 (4,437–5,169)
Black	*	*	*	175	1.2 (1.0–1.4)	582 (476–689)
Hispanic	*	*	*	*	*	*
Region						
Midwest	349	1.1 (1.0–1.3)	1,339 (1,158–1,519)	593	1.9 (1.7–2.1	1,974 1,771–2,180)
Northeast	516	2.0 (1.6–2.2)	1,979 (1,669–2,290)	608	2.2 (2.0–2.5)	2,024 (1,801–2,250)
South	489	1.0 (0.9–1.2)	1,876 (1,573–2,175)	773	1.6 (1.4–1.7)	2,573 (2,327–2,822)
West	232	0.8 (0.7–1.0)	890 (729–1,051)	446	1.5 (1.3–1.7)	1,484 (1,278–1,691)
MSA						
Rural	*	*	*	*	*	*
Urban	1,478	1.5 (1.3–1.6)	5,670 (5,194–6,149)	2,310	2.2 (2.1–2.3)	7,688 (7,276–8,101)

*Figure does not meet standard for reliability or precision.

MSA, metropolitan statistical area.

[a]Rate per 100,000 is based on 1994–2000 population estimates from Current Population Survey (CPS), CPS Utilities, Unicon Research Corporatiion, for relevant demographic

[b]Rate per 100,000 adults 35+ visits with partial nephrectomy performed is based on estimated number of visits for renal cell carcinoma in HCUP_NIS 1994–2000.

[c]Persons of other races, missing or unavailable race and ethnicity, and missing MSA are included in the totals.

NOTE: Counts may not sum to totals due to rounding.

SOURCE: Healthcare Cost and Utilization Project Nationwide Inpatient Sample, 1994, 1996, 1998, 2000.

Table 24. Inpatient procedures for open partial nephrectomy in Medicare beneficiaries with kidney cancer, count[a], rate[b] (95% CI), age-adjusted rate[c]

	1992				1995			
	Count	Rate		Age-Adjusted Rate	Count	Rate		Age-Adjusted Rate
Total[d]	360	2,507	(1,361–3,653)		320	2,228	(1,146–3,311)	
Age								
0–64	20	2,083	(0–6,274)		0	0		
65–69	140	3,448	(917–5,980)		100	2,717	(346–5,089)	
70–74	60	1,676	(0–3,575)		120	2,871	(588–5,153)	
75–79	120	3,797	(784–6,810)		100	3,247	(416–6,078)	
80+	20	1,020	(0–3,046)		0	0		
Race/ethnicity								
White	300	2,443	(1,218–3,668)	1,890	280	2,194	(1,055–3,334)	1,648
Black	20	1,789	(0–5,364)	1,700	40	3,636	(0–8,744)	3,237
Asian	…	...		…	0	0		0
Hispanic	…	...		…	0	0		0
N. American Native	…	...		…	0	0		0
Gender								
Male	300	3,580	(1,794–5,366)	3,084	160	2,010	(625–3,395)	1,566
Female	60	1,003	(0–2,140)	748	160	2,500	(780–4,220)	1,864
Region								
Midwest	60	1,987	(0–4,238)	1,425	120	3,681	(760–6,602)	2,652
Northeast	100	3,268	(419–6,117)	2,263	60	2,256	(0–4,812)	1,663
South	160	3,587	(1,128–6,047)	2,938	100	2,304	(292–4,316)	1,795
West	40	3,077	(0–7,389)	4,644	40	2,899	(0–6,958)	2,250

	1998				2001			
	Count	Rate		Age-Adjusted Rate	Count	Rate		Age-Adjusted Rate
Total[d]	400	2,985	(1,693–4,277)		460	2,934	(1,750–4,117)	
Age								
0–64	60	4,478	(0–9,560)		40	2,299	(0–5,511)	
65–69	60	1,875	(0–4,000)		140	3,271	(869–5,673)	
70–74	80	2,454	(54–4,854)		80	2,286	(50–4,522)	
75–79	100	3,497	(449–6,544)		160	4,819	(1,527–8,111)	
80+	100	5,556	(731–10,380)		40	2,105	(0–5,045)	
Race/ethnicity								
White	320	2,817	(1,452–4,182)	2,293	440	3,240	(1,905–4,575)	3,115
Black	60	4,110	(0–8,773)	4,288	20	1,351	(0–4,045)	1,425
Asian	0	0		0	0	0		0
Hispanic	0	0		0	0	0		0
N. American Native	0	0		0	0	0		0
Gender								
Male	300	3,807	(1,909–5,705)	4,001	200	2,227	(857–3,597)	2,242
Female	100	1,812	(228–3,395)	1,396	260	3,881	(1,802–5,959)	3,138
Region								
Midwest	140	5,147	(1,386–8,908)	4,236	120	3,333	(686–5,981)	2,750
Northeast	60	3,000	(0–6,402)	1,928	180	6,923	(2,501–11,345)	5,901
South	80	1,732	(37–3426)	1,718	160	3,030	(949–5,112)	3,068
West	120	8,451	(1,820–15,081)	11,585	0	0		0

…data not available.
[a]Unweighted counts multiplied by 20 to arrive at values in table.
[b]Rate per 100,000 Medicare beneficiaries with renal cell carcinoma.
[c]Age-adjusted to the US Census-derived age distribution of the year under analysis.
[d]Persons of other races, unknown race and ethnicity, and other region are included in the total.
NOTE: Counts less than 600 should be interpreted with caution.
SOURCE: Centers for Medicare and Medicaid Services, 1992, 1995, 1998, 2001.

Table 25. Inpatient procedures for open radical nephrectomy in Medicare beneficiaries with kidney cancer, count[a], rate[b] (95% CI), age-adjusted rate[c]

	1992				1995			
	Count	Rate		Age-Adjusted Rate	Count	Rate		Age-Adjusted Rate
Total[d]	5,520	38,440	(34,873–42,007)		5,200	36,212	(32,688–39,736)	
Age								
0–64	300	31,250	(17,649–44,851)		380	30,645	(18,842–42,448)	
65–69	1,800	44,335	(37,443–51,227)		1,340	36,413	(29,395–43,431)	
70–74	1,260	35,196	(28,132–42,259)		1,420	33,971	(27,497–40,445)	
75–79	1,340	42,405	(34,615–50,195)		1,160	37,662	(29,923–45,401)	
80–84	700	35,714	(26,058–45,370)		660	43,421	(32,020–54,822)	
85–89	100	20,000	(3,148–36,852)		220	44,000	(23,088–64,912)	
90–94	20	16,667	(0–59,510)		20	16,667	(0–59,510)	
95+	0	0			0	0		
Race/ethnicity								
White	4,740	38,599	(34,738–42,461)	36,966	4,820	37,774	(34,002–41,546)	36,879
Black	460	41,071	(27,777–54,366)	37,114	200	18,182	(7,659–28,705)	17,059
Asian	…	...		…	0	0		0
Hispanic	…	...		…	40	22,222	(0–56,117)	31,365
N. American Native	…	...		…	0	0		0
Gender								
Male	3,280	39,141	(34,448–43,833)	36,726	3,020	37,940	(33,152–42,727)	37,418
Female	2,240	37,458	(31,940–42,976)	35,103	2,180	34,063	(28,842–39,283)	33,384
Region								
Midwest	1,320	43,709	(35,706–51,711)	33,865	1,380	42,331	(34,666–49,997)	39,359
Northeast	1,320	43,137	(35,201–51,074)	43,416	1,120	42,105	(33,605–50,606)	39,296
South	2,180	48,879	(42,267–55,491)	45,682	2,140	49,309	(42,604–56,014)	51,216
West	680	52,308	(39,835–64,780)	51,480	560	40,580	(28,697–52,462)	44,555

Continued on next page

Table 25 (continued). Inpatient procedures for open radical nephrectomy in Medicare beneficiaries with kidney cancer, count[a], rate[b] (95% CI), age-adjusted rate[c]

	1998				2001			
	Count	Rate		Age-Adjusted Rate	Count	Rate		Age-Adjusted Rate
Total[d]	4,640	34,627	(31,015–38,239)		4,580	29,209	(26,019–32,399)	
Age								
0–64	340	25,373	(14,679–36,067)		300	17,241	(9,144–25,339)	
65–69	1,080	33,750	(26,344–41,156)		1,340	31,308	(25,045–37,572)	
70–74	1,140	34,969	(27,571–42,368)		920	26,286	(19,699–32,872)	
75–79	1,000	34,965	(27,054–42,876)		1,260	37,952	(30,493–45,411)	
80–84	660	36,667	(26,517–46,816)		660	34,737	(24,986–44,488)	
85–89	340	50,000	(32,292–67,708)		100	13,158	(1,898–24,418)	
90–94	80	30,769	(1,740–59,799)		0	0		
95+					0	0		
Race/ethnicity								
White	4,000	35,211	(31,271–39,151)	33,633	4,100	30,191	(26,730–33,653)	26,801
Black	380	26,027	(15,719–36,336)	29,203	280	18,919	(9,783–28,055)	19,636
Asian	20	50,000	(0–685,310)	17,000	20	50,000	(0–685,310)	17,000
Hispanic	120	46,154	(14,799–77,509)	37,910	20	14,286	(0–49,242)	11,571
N. American Native	0	0		0	0	0		0
Gender								
Male	2,820	35,787	(31,033–40,541)	34,839	2,880	32,071	(27,737–36,405)	29,330
Female	1,820	32,971	(27,390–38,552)	30,721	1,700		(20,689–30,057)	23,368
Region								
Midwest	1,000	36,765	(28,558–44,972)	34,805	1,380	38,333	(31,162–45,504)	34,843
Northeast	860	43,000	(33,127–52,873)	38,096	760	29,231	(21,308–37,154)	24,153
South	1,940	41,991	(35,579–48,403)	42,577	1,880	35,606	(29,792–41,420)	33,661
West	800	56,338	(44,515–68,161)	46,732	540	36,486	(25,257–47,716)	34,044

…data not available.

[a]Unweighted counts multiplied by 20 to arrive at values in table.

[b]Rate per 100,000 Medicare beneficiaries with renal cell carcinoma.

[c]Age-adjusted to the US Census-derived age distribution of the year under analysis.

[d]Persons of other races, unknown race and ethnicity, and other region are included in the totals.

NOTE: Counts less than 600 should be interpreted with caution.

SOURCE: Centers for Medicare and Medicaid Services, 1992, 1995, 1998, 2001.

Table 26. VA users with laparoscopic partial nephrectomy for kidney cancer, 1998–2003 (merged), count, age-adjusted rate[a]

	1998–2000		2001		2002		2003	
	Count	Rate	Count	Rate	Count	Rate	Count	Rate
Total	0	*	4	*	12	*	6	*
Age-adjusted Total	0	*	4	*	9	*	4	*
Age								
< 25	0	*	0	*	0	*	0	*
25–34	0	*	0	*	0	*	0	*
35–44	0	*	0	*	1	*	0	*
45–54	0	*	4	*	3	*	1	*
55–64	0	*	0	*	4	*	2	*
65–74	0	*	0	*	2	*	1	*
75–84	0	*	0	*	0	*	0	*
85+	0	*	0	*	1	*	0	*
Gender		*		*		*		*
Male	0	*	4	*	12	*	6	*
Female	0	*	0	*	0	*	0	*
Race/ethnicity		*		*		*		*
White	0	*	2	*	10	*	3	*
Black	0	*	0	*	0	*	1	*
Hispanic	0	*	1	*	0	*	0	*
Other	0	*	0	*	0	*	1	*
Unknown	0	*	1	*	2	*	1	*
Insurance Status		*		*		*		*
No insurance/self-pay	0	*	4	*	10	*	5	*
Medicare	0	*	0	*	2	*	0	*
Medicaid	0	*	0	*	0	*	0	*
Private Insurance/HMO	0	*	0	*	0	*	1	*
Other Insurance	0	*	0	*	0	*	0	*
Unknown	0	*	0	*	0	*	0	*
Region		*		*		*		*
Eastern	0	*	2	*	0	*	2	*
Central	0	*	0	*	0	*	1	*
Southern	0	*	2	*	10	*	3	*
Western	0	*	0	*	2	*	0	*

*Figure does not meet standard for reliability or precision.

[a]Rate per 100,000 veterans using the VA system, age-adjusted to 2000.

SOURCE: Inpatient and Outpatient Files, VA Information Resource Center (VIReC), Veterans Affairs Health Services Research and Development Service Resource Center.

development of techniques for laparoscopic partial nephrectomy and its widespread adoption (33). Of the datasets used in this analysis, only the VA dataset captures this trend.

Improvements in perioperative care have led to shorter hospitalizations for surgery patients in general and have impacted length of stay for patients undergoing surgery for kidney cancer as well. These include improvements in anesthesia, postoperative pain management, dietary management, and early mobilization. Inpatient care accounts for a large proportion of the cost of treating RCC, and decreases in the length of hospital stays are important for decreasing the overall costs associated with such treatment. HCUP data from 1994, 1996, 1998, and 2000 show a steady decrease in the inpatient length of stay for a primary diagnosis of RCC; mean length of hospitalization decreased by 25% from 1994 to 2000 (Table 27). The reduced length of stay is seen consistently across genders, age groups, races, and regions. In 2000, the mean length of stay was 6.4 days, and the median length of stay was 5 days. With the wider adoption of laparoscopy, the length of stay will decrease significantly further, as length

Table 27. Length of stay (LOS) for primary diagnosis of kidney cancer

	1994				1996			
	Count	LOS (Mean)	LOS (Median)	LOS (Max)	Count	LOS (Mean)	LOS (Median)	LOS (Max)
Total	23,006	8.1	7	97	24,528	7.2	6	154
Age								
35–44	1,445	7.1	6	29	1,630	6.2	5	42
45–54	3,287	7.2	6	41	3,675	6.2	5	42
55–64	5,243	7.7	6	68	5,832	6.8	5	154
65–74	7,368	8.3	7	72	7,342	7.4	6	78
75–84	4,675	9	7	97	5,054	8.5	6	111
85+	989	9.8	8	87	995	8.3	6	62
Gender								
Male	13,872	7.8	6	73	14,828	7.0	5	154
Female	9,134	8.6	7	97	9,700	7.7	6	111
Race/ethnicity								
White	15,423	8.0	7	97	16,356	7.2	6	111
Black	1,561	9.8	7	68	1,657	8.2	6	78
Hispanic	710	8.9	7	34	893	8.0	5	154
Region								
Northeast	5,206	9.2	7	97	5,709	8.2	6	78
Midwest	5,885	8.1	7	67	6,277	7.2	6	111
South	8,273	7.9	7	67	8,727	7.1	6	154
West	3,643	7.0	6	72	3,814	6.3	5	53
MSA								
Rural	3,318	7.6	6	64	3,048	6.4	5	111
Urban	19,648	8.2	7	97	21,451	7.4	6	154

	1998				2000			
	Count	LOS (Mean)	LOS (Median)	LOS (Max)	Count	LOS (Mean)	LOS (Median)	LOS (Max)
Total	26,069	6.7	5	255	30,045	6.4	5	117
Age								
35–44	1,823	5.6	5	43	1,986	5.5	4	50
45–54	4,405	5.8	5	44	5,474	5.9	5	116
55–64	6,114	6.3	5	83	7,187	5.9	5	84
65–74	7,724	6.8	5	76	8,428	6.5	5	103
75–84	5,011	7.8	6	255	5,732	7.2	6	64
85+	991	8.1	7	66	1,239	8.4	6	117
Gender								
Male	15,587	6.5	5	75	18,217	6.2	5	87
Female	10,483	6.9	5	255	11,818	6.8	5	117
Race/ethnicity								
White	16,713	6.5	5	255	18,536	6.2	5	117
Black	1,817	7.5	5	70	2,002	8.1	6	116
Hispanic	1,142	7.5	5	75	1,418	6.8	5	58
Region								
Northeast	6,256	7.1	5	136	6,627	6.8	5	117
Midwest	6,260	7.1	6	255	7,469	6.2	5	40
South	9,550	6.3	5	83	10,758	6.4	5	103
West	4,004	6.2	5	71	5,191	6.0	5	116
MSA								
Rural	2,807	6.2	5	83	3,042	6.1	5	55
Urban	23,170	6.7	5	255	26,954	6.4	5	117

MSA, metropolitan statistical area.

Adults 35+ of other races, missing or unavailable race and ethnicity, and missing MSA are included in the totals.

NOTE: Counts may not sum to totals due to rounding

SOURCE: Healthcare Cost and Utilization Project Nationwide Inpatient Sample, 1994, 1996, 1998, 2000.

Table 28. Mortality rates and length of stay (LOS), by type of nephrectomy, 1993–1997, 95% CI

	Total	Annual Hospital Nephrectomy Volume: Low-Volume Hospitals (< 15 cases/yr)	Medium-Volume Hospitals (15–33 cases/yr)	High-Volume Hospitals (> 33 cases/yr)	P-value
Mortality (%)					
All types of nephrectomy	1.39	1.60	1.49	1.04	0.02
Partial nephrectomy	0.85	2.25	0.57	0.36	0.02
Radical nephrectomy	1.38	1.46	1.52	1.10	0.14
Nephroureterectomy	1.68	2.05	1.66	1.08	0.31
Length of stay (days)					
All types of nephrectomy	7.80 (7.71–7.89)	7.85 (7.71–7.99)	7.83 (7.67–7.99)	7.70 (7.54–7.86)	0.35
Partial nephrectomy	7.34 (7.05–7.63)	7.97 (7.32–8.62)	7.43 (6.90–7.96)	7.06 (6.65–7.47)	0.00
Radical nephrectomy	7.77 (7.67–7.87)	7.76 (7.60–7.92)	7.78 (7.60–7.96)	7.73 (7.55–7.91)	0.84
Nephroureterectomy	8.21 (7.98–8.44)	8.31 (7.92–8.70)	8.24 (7.87–8.61)	7.99 (7.60–8.38)	0.57

SOURCE: Reprinted from Urology, 63, Taub DA, Miller DC, Cowan JA, Dimick JB, Montie JE, Wei JT. Impact of surgical volume on mortality and length of stay after nephrectomy, 862–867, Copyright 2004, with permission from Elsevier.

of stay after laparoscopic surgery for kidney cancer is approximately half that after open surgery. Length-of-stay data for laparoscopic surgery are not available in the datasets used in this analysis.

Recent investigations have brought attention to the concept of quality of care delivered by hospitals and by individual surgeons in an attempt to analyze and improve surgical outcomes. Leaders in this field, including RAND, the Veterans Affairs Outcomes Group, and the Leapfrog Group, have demonstrated that mortality rates are lower at hospitals where high volumes of major surgery are performed (34). In addition, individual surgeon volume has an inverse relationship with complication rates (35). One of the findings of this research is that mortality rates for certain types of surgery could be reduced if patients

Table 29. Characteristics of patients undergoing nephrectomy for kidney cancer, 1993–1997

Factor	Total	Annual Hospital Nephrectomy Volume: Low-Volume Hospitals (< 15 cases/yr)	Medium-Volume Hospitals (15-33 cases/yr)	High-Volume Hospitals (> 33 cases/yr)	P-value
Number of hospitals, n(%)	962 (100%)	717 (74.5)	165 (17.2)	80 (8.3)	…
Number of patients, n(%)	20,765 (100%)	7,552 (36.3)	7,104 (34.2)	6,109 (29.4)	…
Mean age (SD) in yrs	62.8 (15.4)	64.6 (13.9)	63.2 (15.1)	60.2 (17.1)	< 0.001
Sex (% male)	60.0	60.0	60.0	62.0	0.08
Race (% white)	68.4	68.6	68.6	67.8	0.47
Urgent admission (%)	22.5	28.3	19.2	19.3	< 0.001
Mortality (%)	1.4	1.6	1.5	1.0	0.02
Length of stay (days)	7.8	7.9	7.9	7.7	0.35
Comorbid conditions (%)					
Chronic obstructive pulmonary disease	8.1	10.3	7.6	5.9	< 0.001
Diabetes mellitus	10.6	10.7	10.9	10.2	0.39
Solid tumor metastasis	11.4	10.7	11.0	12.8	< 0.001
Myocardial infarction	3.1	2.4	3.3	3.6	< 0.001
Liver disease	0.7	0.7	0.7	0.7	0.86
Peripheral vascular disease	2.5	2.8	2.6	2.2	0.09
Chronic renal disease	0.3	0.2	0.2	0.7	< 0.001

…data not available.

SOURCE: Reprinted from Urology, 63, Taub DA, Miller DC, Cowan JA, Dimick JB, Montie JE, Wei JT. Impact of surgical volume on mortality and length of stay after nephrectomy, 862–867, Copyright 2004, with permission from Elsevier.

Table 30. Expenditures for kidney cancer, by site of service (% of total)

Service Type	1994		1996		1998		2000	
Hospital Outpatient	$13,315,994	4.9%	$14,501,579	4.6%	$20,096,354	5.4%	$17,570,762	4.4%
Physician Office	$17,650,817	6.4%	$19,222,351	6.1%	$31,895,869	8.6%	$30,903,303	7.7%
Ambulatory Surgery	$8,138,812	3.0%	$8,863,449	2.8%	$9,131,076	2.5%	$6,650,790	1.7%
Emergency Room	$0	0.0%	$0	0.0%	$0	0.0%	$0	0.0%
Inpatient	$235,335,352	85.8%	$273,243,539	86.5%	$309,230,478	83.5%	$346,165,817	86.3%
TOTAL	$274,440,974		$315,830,918		$370,353,777		$401,290,672	

SOURCE: National Ambulatory and Medical Care Survey; National Hospital and Ambulatory Medical Care Survey; Healthcare Cost and Utilization Project; Medical Expenditure Panel Survey, 1994, 1996, 1998, 2000.

chose a hospital where more of those surgeries are performed. A strong case is being made for transparent exchange of standard measures of outcomes, which would recognize hospitals for superior outcomes and would improve the overall quality of the healthcare system.

Surgery for kidney cancer has been evaluated in this fashion (36). Not surprisingly, hospitals where high volumes of kidney surgery are performed were found to have lower mortality rates (Table 28). This was the case despite the higher rate of risk factors for surgical complications such as emphysema, history of heart attack, metastatic disease, and chronic renal disease (Table 29) present in patients undergoing surgery at high-volume hospitals. While laparoscopic kidney surgery has not yet been analyzed for outcomes based on surgical volume, this will likely be pursued in the near future.

ECONOMIC IMPACT

Total expenditures in the United States for RCC were $401 million in 2000, a 46% increase since 1994 (Table 30). This increase is largely attributable to rising expenditures for inpatient services, although hospital outpatient services and physician office visits have also increased, albeit inconsistently, since 1994. Inpatient services accounted for about 85% of total RCC expenditures throughout the study period.

Expenditures for RCC by Medicare enrollees age 65 and over amounted to $119 million in 2001, an increase of about $26 million since 1992 (Table 31). Inpatient services and physician office visits

Table 31. Expenditures for Medicare beneficiaries for treatment of kidney cancer, by site of service (% of total)

	Age 65 and over							
Service Type	1992		1995		1998		2001	
Hospital Outpatient	$4,692,160	5.0%	$5,966,740	6.0%	$7,638,160	7.0%	$6,976,800	5.8%
Physician Office	$5,153,280	5.5%	$7,078,500	7.1%	$12,384,000	11.3%	$13,720,940	11.5%
Ambulatory Surgery	$1,092,000	1.2%	$1,299,480	1.3%	$1,812,480	1.7%	$1,751,220	1.5%
Emergency Room	$269,700	0.3%	---	0.0%	$455,600	0.4%	---	0.0%
Inpatient	$82,586,560	88.1%	$85,331,180	85.6%	$87,541,560	79.7%	$96,849,520	81.2%
TOTAL	$93,793,700		$99,675,900		$109,831,800		$119,298,480	
	Under 65							
Service Type	1992		1995		1998		2001	
Hospital Outpatient	$597,780	9.6%	$802,280	36.3%	$598,780	6.3%	$376,800	3.8%
Physician Office	$604,440	9.7%	$1,408,800	63.7%	$588,600	6.2%	$1,523,200	15.4%
Ambulatory Surgery	---	0.0%	---	0.0%	---	0.0%	---	0.0%
Emergency Room	---	0.0%	---	0.0%	---	0.0%	---	0.0%
Inpatient	$5,032,500	80.7%	---	0.0%	$8,351,640	87.6%	$8,020,320	80.8%
TOTAL	$6,234,720		$2,211,080		$9,539,020		$9,920,320	

SOURCE: Centers for Medicare and Medicaid Services, 1992, 1995, 1998, 2001.

Table 32. Estimated annual expenditures of privately insured employees with and without a medical claim for kidney cancer in 2002[a]

	Annual Expenditures (per person)					
	Persons without Kidney Cancer (N=394,175)			Persons with Kidney Cancer (N=386)		
	Medical	Rx Drugs	Total	Medical	Rx Drugs	Total
Total	$3,196	$1,317	$4,513	$13,418	$3,250	$16,668
Age						
35–49	$2,922	$1,215	$4,137	$13,340	$3,499	$16,839
50–54	$3,469	$1,431	$4,900	$15,670	$5,434	$21,104
55–59	$3,441	$1,403	$4,844	$20,014	$2,353	$22,367
Region						
Midwest	$3,062	$1,256	$4,318	$12,843	$3,124	$15,967
Northeast	$3,283	$1,403	$4,686	$13,771	$3,462	$17,233
South	$3,317	$1,292	$4,609	$13,916	$3,157	$17,073
West	$2,826	$1,294	$4,120	$11,854	$3,223	$15,077

Rx, Prescription.

[a]The sample consists of primary beneficiaries ages 35 to 64 having employer-provided insurance who were continuously enrolled in 2002. Estimated annual expenditures were derived from multivariate models that control for age, gender, work status (active/retired), median household income (based on zip code), urban/rural residence, medical and drug plan characteristics (managed care, deductible, co-insurance/co-payments) and binary indicators for 28 chronic disease conditions. Predicted expenditures for persons age 60 to 64 are omitted due to small sample size.

SOURCE: Ingenix, 2002.

accounted for the majority of this increase, with expenditures for office visits increasing 166% since 1992. Inpatient services accounted for more than 80% of RCC expenditures in 2001, similar to the proportion in the general population. Expenditures by Medicare enrollees under the age of 65 were $10 million in 2001, an increase of $4 million over the level in 1992.

Individual-level expenditures for RCC were estimated using risk-adjusted regression models controlling for age, sex, work status, income, urban or rural residence, and health plan characteristics (Table 32). Average annual expenditures for 35- to 59-year-olds with employer-provided insurance who were treated for RCC were $16,668, compared with $4,513 for similar individuals not treated for the condition; an incremental cost of $12,155 was thus associated with a diagnosis of RCC. The reasons for the substantial difference are not entirely clear, but the excess expenditures may be for major surgery associated with RCC and also for end-of-life care. Individual-level costs varied little by region.

Overall, 48% of men and women with a diagnosis of RCC missed an average of more than 12 days of work per diagnosis. This substantial work loss is probably attributable to recovery time associated with surgical management of RCC (Table 33). An annual average of about 7 days were missed for outpatient visits, while 5 days were missed for inpatient stays. Men and women did not appear to differ with respect to the average number of days missed as a result of inpatient stays for RCC. Each inpatient stay resulted in more than 13 days of work loss (it must be noted that this finding is based on only 20 stays). About 11 hours of work were missed for each outpatient visit. There was some variation by region, with more work missed per visit in the South and West than in the Northeast and Midwest regions.

Healthcare expenditures for RCC were substantial in both the general population and among Medicare enrollees age 65 and over. Treatment and management of individuals with RCC was far more expensive than that of individuals without RCC, primarily because of the enormous excess costs associated with RCC in men. Nearly half of the individuals diagnosed with RCC missed work, and each inpatient stay and outpatient visit resulted in a large amount of work loss.

CONCLUSIONS

The incidence of kidney cancer has increased over the past decade and will likely accelerate in the future because of the aging of the US population and the increase in comorbid diseases associated with kidney cancer. African Americans have an increased risk of

Table 33. Average annual work loss of persons treated for kidney cancer, 1999 (95%CI)

	Number of Workers[a]	% Missing Work	Average Work Absence (hrs) Inpatient[b]		Outpatient[b]		Total	
Total	52	48%	40.3	(15.6-65.1)	56.3	(0–116.1)	96.6	(24.4–168.8)
Age								
18–29	1	100%	181	…	181	…	362	…
30–39	2	50%	48.0	(0–657.9)	52.0	(0–712.7)	100	(0–1370.6)
40–49	9	78%	26.8	(0–73.5)	101.7	(0–301.6)	129	(0–374.0)
50–64	40	40%	39.5	(9.3–69.6)	43.1	(0–111.2)	82.6	(1.5–163.6)
Gender								
Male	42	48%	40.5	(11.5–69.5)	60.9	(0–134.7)	101.3	(13.8–188.9)
Female	10	50%	39.7	(0–91.7)	36.9	(0–188.9)	76.6	(0–179.9)
Region								
Midwest	12	42%	56.4	(0–119.2)	26.4	(0–62.9)	82.8	(0–165.9)
Northeast	7	29%	73.1	(0–239.4)	3.4	(0–11.80)	76.6	(0–251.2)
South	21	52%	24.9	(2.2–47.5)	78.3	(0–211.2)	103	(0–252.9)
West	5	40%	37.1	(0–14.0)	164	(0-600.9)	201	(0–740.9)
Unknown	7	71%	28.6	(0–61.1)	17.1	(0–53.0)	45.7	(0–110.6)

…data not available.

[a]Individuals with an inpatient or outpatient claim for renal cell carcinoma and for whom absence data were collected. Work loss based on reported absences contiguous to the admission or discharge dates of each hospitalization or the date of the outpatient visit.

[b]Inpatient and outpatient include absences that start or stop the day before or after a visit.

Source: Marketscan Health and Productivity Management, 1999.

Table 34. Average work loss[a] associated with a hospital stay or an ambulatory care visit for kidney cancer (95% CI)

	Number of Inpatient Stays	Average Hours Missed for Inpatient Stays		Number of Outpatient Visits	Average Hours Missed for Outpatient Visits	
Total	20	105	(50–160)	273	10.6	(8–13)
Age						
18–29	1	181	...	...	45.2	(0–136)
30–39	1	96	...	3	34.7	(0–184)
40–49	3	80	(0–306)	70	13.1	(8–18)
50–64	15	105	(32–178)	200	8.6	(6–12)
Gender						
Male	17	100	(35–165)	252	10.1	(8–13)
Female	3	132	(0–314)	21	14.8	(1–29)
Region						
Midwest	5	135	(0–280)	60	5.0	(0–10)
Northeast	2	256	(0–3102)	35	0.7	(0–2)
South	8	65	(12–118)	95	17.3	(12–23)
West	1	185	…	55	14.9	(9–21)
Unknown	4	50	(0–101)	28	4.3	(0–12)

…data not available.

[a]Work loss is based on reported absences contiguous to the admission and discharge dates of each hospitalization or the date of outpatient visit.

Source: Marketscan Health and Productivity Management, 1999.

kidney cancer and a worse prognosis, particularly in men younger than 60. Trends in incidence, survival, and treatment of kidney cancer in other minorities are poorly characterized. Costs associated with the diagnosis and treatment of kidney cancer totaled approximately $400 million in 2000 and places a considerable burden on the US healthcare system. Inpatient stays, recovery from surgery, and outpatient care keep patients away from other productive activity for substantial amounts of time. However, inpatient stays have decreased over the past decade, and the widespread adoption of laparoscopic techniques will further decrease this costly component of treatment.

RECOMMENDATIONS

Opportunities abound for improving our understanding of the burden of kidney cancer in the United States. Tumor registry data, such as those from SEER, are critically important to the appreciation of racial variations in incidence and survival. Data on minority patients are relatively scant, and greater efforts should be made to capture these numbers and to screen populations at risk. A national cancer registry, based on the SEER model, could further the understanding of kidney cancer by capturing more cases. The SEER data could and should be improved by the separation of upper-tract transitional cell carcinoma from RCC, since these diseases behave very differently. Current ICD-9 codes already make this distinction, but they could be modified to separate pediatric kidney tumors as well, since these tumors also have different treatment and prognosis.

Further investigation into the SEER database with linked SEER and Medicare data could help improve the understanding of the role of end-stage renal disease in the increased incidence of kidney cancer. Prior studies indicate that patients on dialysis clearly have an increased risk of kidney cancer (37), but these analyses do not account for the possibility that patients are living longer on dialysis and after kidney transplant and hence are exposed to the attendant age-related risk of developing kidney cancer.

From the clinical perspective, major efforts should be made in the prevention of diseases that are associated with the development of kidney cancer, including hypertension and obesity. It would also be valuable to ascertain why these diseases are associated with development of RCC. From the research perspective, basic science inquiries into the genetic alterations seen in kidney cancer should receive increased support, as this understanding could lead to more effective treatments for metastatic disease, which is rapidly fatal. Research should also focus on features of the increasingly diagnosed, small, incidental RCCs, some of which may behave in indolent fashion and may not require treatment.

The datasets used in this analysis do not capture standard immunotherapeutic care or the new targeted therapies (tyrosine kinase inhibitors) for patients with metastatic disease. These treatments are quite costly and until recently have had a relatively small impact on survival. The high costs of metastatic disease and end-of-life care probably contribute significantly to the burden of this disease in the United States. Understanding these costs might help garner support for clinical trials rather than utilization of standard immunotherapeutic therapies with marginal survival benefit. In addition, the datasets used in this analysis do not capture newer, less-invasive therapies for localized disease, such as radiofrequency ablation and cryotherapy. It would be useful to understand the degree of adoption of these thermal therapies, along with their costs and effectiveness.

The evolution of surgical techniques has understandably engendered controversy in the surgical management of kidney cancer, and the field is currently in flux. While it appears clear that laparoscopic techniques will ultimately replace traditional surgery in the most common cases of kidney cancer, more data are necessary to support this transformation. In a few years, the datasets used in this analysis for length of stay will begin to reflect the trend toward laparoscopic techniques. Currently the equipment costs for laparoscopic surgery somewhat offset the benefits of shorter hospitalization, but over time these costs will likely decrease.

The compelling case for laparoscopic techniques in the treatment of kidney cancer could best be addressed, however, by looking at disability times and costs in datasets of large disability insurance carriers. As shorter hospitalization times and earlier return to work are increasingly recognized, payors should reimburse these procedures at a higher rate. Third-party payors will probably support laparoscopic (or "minimally invasive") techniques for retired as well as employed patients when the overall cost of treatment is shown to be less. There is recent precedent for this in the increased reimbursement for less-invasive forms of treatment for benign prostatic hyperplasia (see the benign prostatic hyperplasia chapter in this compendium).

Outcomes research in quality of care is a growing field that will play an increasingly powerful role in healthcare delivery in the future. More effort should be made and more support should be offered for outcomes studies in the treatment of kidney cancer aimed at improving outcomes for patients and providing high-quality care in all regions of the country. One potential issue that could arise from such studies is increased regionalization of care, with patients having to travel long distances from their homes for treatment.

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