Urologic Diseases in America Project

Kidney Cancer

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Purpose: We quantified the burden of kidney cancer in the United States by identifying trends in the use of health care resources and estimating the economic impact of the disease.
Materials and Methods: The analytical methods used to generate these results were described previously.
Results: The incidence of all stages of kidney cancer is increasing in America, particularly T1 disease. Rates are increasing more rapidly in the black than in the white population and survival is worse for black individuals at all stages of diagnosis. Total expenditures for kidney cancer were $401 million in 2000, representing a 46% increase from 1994. Approximately 85% of health care dollars spent on kidney cancer were for inpatient care with steady increases through the 1990s. Regarding treatment, more partial nephrectomies were performed in Medicare patients as the 1990s progressed. Health Care Cost and Utilization Project data showed an increase in the number of inpatient hospitalizations but this trend was not seen in the Centers for Medicare and Medicaid Services data set. Length of stay decreased from 1994 to 2000 in the Health Care Cost and Utilization Project database. The adoption of laparoscopic techniques began to appear in the Veterans Affairs data set in 2001 and it increased thereafter.
Conclusions: Increasing trends in the incidence of and costs associated with kidney cancer have been apparent for more than 10 years. As the population ages and the prevalence of risk factors such as obesity and hypertension increases, the burden of disease will increase significantly. Consideration should be given to expanding tumor registries such as Surveillance, Epidemiology and End Results. Treatment databases could better characterize the cost and effectiveness of treatment for metastatic disease and of trends in the adoption of laparoscopy.

Key Words: kidney, kidney neoplasms, carcinoma, mortality, health care costs

Kidney cancer, the third most common urological malignancy and the seventh most common cancer overall, was diagnosed in an estimated 35,000 Americans in 2005 and almost 13,000 died of it.[1] That year kidney cancer represented 3% of new cancer cases and 3% of all cancer deaths in men. Kidney cancer occurs about half as often in women and it represents less than 2% of female cancer cases and deaths.[1] When discovered in its early stages, the disease is curable, but advanced or metastatic kidney cancer is usually fatal. Fortunately the recent increase in the kidney cancer incidence reflects primarily small tumors discovered incidentally during abdominal imaging.

Kidney cancer imposes a significant burden on the health care system in the United States because its diagnosis involves advanced radiological testing and its treatment often involves surgery, hospitalization and regular surveillance visits to assess 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 an estimated 1% of visits to urologists are for kidney cancer treatment. We explored the burden of kidney cancer in the United States by quantifying and identifying trends in the use of health care resources and estimating the economic impact of the disease. Results of the Urologic Diseases in America Project can be used to help allocate research and clinical resources, and determine future research needs.

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MATERIALS AND METHODS

The analytical methods used to generate these results were described previously.[2,3]

RESULTS

Incidence and Survival

The incidence of kidney cancer increased slowly in the last 3 decades according to the SEER database and American Cancer Society Surveillance Research Cancer Statistics.[1,4] While most of the increased incidence was seen in small, organ confined disease, there was also a significant increase in the incidence of locally advanced and metastatic disease. The increase in incidence was likely due to 2 phenomena, including 1) a true increase in incidence and increased detection due to increasing rates of abdominal imaging and 2) most of the increased incidence was that of small, low stage tumors.[5,6]

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TABLE 1. *Age adjusted renal carcinoma incidence rates by race/ethnicity and gender*

	All			Whites			Blacks		
	Totals	Males	Females	Totals	Males	Females	Totals	Males	Females
Diagnosis yr:									
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
Diagnosis age:									
All ages	11.7	16.2	8.1	11.9	16.5	8.2	13.7	18.9	10.0
Younger than 65	6.1	8.2	4.2	6.2	8.2	4.2	7.5	9.8	5.5
Older than 65	50.0	71.8	34.8	51.2	73.5	35.6	56.9	81.7	41.0
All ages	8.2	11.2	5.7	8.4	11.4	5.8	9.8	13.3	7.2

SEER 9 areas for all ages, rates per 100,000 and age adjusted to the International Agency for Research on Cancer world standard population, and approximately 12% renal pelvis cancer (source: SEER Program [www.seer.cancer.gov] SEER*Stat Database: Incidence–SEER 9 Regs Public Use, November 2004 Sub [1973 to 2002]. National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released April 2005, based on the November 2004 submission).

SEER data showed that kidney cancer incidence increased with age, in that most disease was diagnosed in patients older than 65 years (table 1). SEER data also showed that in men and women younger than 65 years the incidence was higher in black than in white individuals. The reasons for this are unclear and may be related to comorbid conditions such as hypertension, which is more common in black individuals, or to genetic variations that have not yet been defined. In all groups the incidence increased with age up to the ninth decade of life (table 2). Further analysis of SEER data showed that, while kidney cancer occurred approximately twice as often in men as in women, its rate was also increasing in women. In addition, the incidence was increasing more rapidly in black than in white individuals and most rapidly in black women.[6] When age and race were considered together, black American men younger than 60 years had the most rapid increase in the incidence of RCC.[7] SEER data also indicated an increasing incidence in Asian/Pacific Islander and Hispanic individuals, while the incidence in Native American/Alaskan native individuals was stable.

Overall survival rates for patients with kidney cancer increased from 1992 to 2001, possibly reflecting that treatment was more effective or more likely that more low stage tumors were being diagnosed (table 3). However, racial and gender disparities in survival were apparent in these data, which showed that black individuals and women had a lower survival rate than the white population, although survival improved in all groups. It is not clear whether this disparity was due to a different biology of disease or to varying rates of comorbidities among racial groups.[7]

Trends in Health Care Resource Use

Inpatient care. Most adult inpatient hospitalizations for kidney cancer were for surgery. CMS data on 1992, 1995, 1998 and 2001 showed a relatively stable number of inpatient hospitalizations for kidney cancer for Medicare beneficiaries at approximately 25/100,000 (table 4). In contrast, HCUP data on 1994, 1996, 1998 and 2000 indicated that admissions for kidney cancer as the primary diagnosis increased slightly from 19/100,000 to 22/100,000 population (table 5). The 2 data sets revealed almost double the number of admissions for men than for women, reflecting the gender distribution of the disease. Also consistent was the increased rate of admissions with advancing age. It is difficult to identify trends in the rates of inpatient care for minority groups in the 2 data sets due to the small number of cases but the HCUP data set revealed a significant increase in inpatient care for Hispanic individuals. HCUP data also showed that a preponderance of inpatient care was delivered at urban centers.

Decreases in hospital length of stay were seen in HCUP data (table 6), likely a reflection of improvements in perioperative and post-hospitalization care, which were witnessed across all surgical specialties. From 1994 to 2000 mean and median hospital stay decreased by 1 or 2 days, or approximately 25%. As laparoscopic techniques are adopted more widely, length of stay should decrease further.

TABLE 2. *Age specific renal carcinoma incidence rates by race/ethnicity and gender*

Diagnosis Age	All Totals	All Males	All Females	Whites Totals	Whites Males	Whites Females	Blacks Totals	Blacks Males	Blacks Females
Younger than 1	1.7	Not available	Not available	Not available	Not available	Not available	Not available	Not available	Not available
1–4	2.1	1.9	2.4	2.4	2.2	2.6	Not available	Not available	Not available
5–9	0.6	Not available	0.7	0.5	Not available	Not available	Not available	Not available	Not available
10–14	Not available	Not available	Not available	Not available	Not available	Not available	Not available	Not available	Not available
15–19	Not available	Not available	Not available	Not available	Not available	Not available	Not available	Not available	Not available
20–24	0.3	Not available	Not available	Not available	Not available	Not available	Not available	Not available	Not available
25–29	0.5	0.6	Not available	0.5	Not available	Not available	Not available	Not available	Not available
30–34	1.3	1.4	1.2	1.2	1.3	1.1	2.0	Not available	Not available
35–39	2.8	3.2	2.4	2.7	3.2	2.3	3.7	Not available	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
Older than 85	42.0	65.2	32.3	42.1	67.6	31.9	42.8	Not available	39.8

SEER 9 areas, rates per 100,000 and age adjusted to the 2000 United States standard population by age groups, and approximately 12% renal pelvis cancer (source: SEER Program [www.seer.cancer.gov] SEER*Stat Database: Incidence–SEER 9 Regs Public Use, November 2004 Sub [1973 to 2002]. National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released April 2005, based on the November 2004 submission).

Outpatient care. Visits to a physician office for the diagnosis of kidney cancer are made for discussing abnormal x-rays, surgical planning, postoperative followup and surveillance. From 1992 to 2001 these visits increased by 29% in the CMS database and by 35% for patients older than 65 years.

Hospital outpatient care. In the CMS data set fewer patients were seen in the hospital outpatient setting than at physician offices. However, similar patterns of increased use were seen in patients older than 65 years in 1992 and 1995, while in 1998 the number of visits was stable and there was a nonsignificant decrease in 2001. As seen in the physician office setting, the male preponderance in this data set was consistent with the incidence of the disease. Regional differences were seen in the CMS data set but they were difficult to interpret since regional variations in incidence were not available.

Ambulatory surgery and emergency room care. Visits to ambulatory surgery and emergency room settings for the primary diagnosis of kidney cancer were uncommon. Data sets from CMS, CPS Survey and the National Survey of Ambulatory Surgery indicated that these settings were not important contributors to the use of the American health care system.

Surgical Trends

Radical nephrectomy performed as a traditional open surgical approach has been the standard operation performed for kidney cancer. However, in the last 2 decades there was a significant shift in the surgical management of kidney cancer to include partial nephrectomy, laparoscopic nephrectomy and laparoscopic partial nephrectomy. CMS data indicated that open radical nephrectomy remained the most common procedure performed for kidney cancer (table 7). However, between 1992 and 2001 there was a significant decrease in the rate of open radical nephrectomy in Medicare beneficiaries.

Given the increasing incidence of small renal tumors, one would expect a parallel increase in the use of partial nephrectomy to manage these tumors, which can follow an indolent course. Partial nephrectomy preserves renal function and minimizes the risk of chronic kidney disease. It is considered by some to be the procedure of choice for small kidney tumors. Increased use of partial nephrectomy was not evident in the CMS data set, which could reflect a quality of care issue since this more technically difficult operation is performed more frequently at academic centers.

The rate of partial nephrectomy increased significantly in the HCUP data set from 1994 to 2000 (table 8). In contrast, CMS data did not show a significant increase in this trend, perhaps because of the smaller number of cases captured in the CMS data sets or because of patient characteristics, advanced age and increased comorbidities, which favored radical nephrectomy in the CMS populations (table 9).

Laparoscopic surgery for kidney cancer has been increasingly adopted since initial reports on the technique in the mid 1990s. 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 use of laparoscopy was difficult to assess in current data sets because data on the recent past were not

TABLE 3. *Five-year Renal carcinoma survival rates by race/ethnicity, gender, diagnosis year and stage*

	All			Whites			Blacks		
Diagnosis Yr:	Totals	Males	Females	Totals	Males	Females	Totals	Males	Females
1960–1963	Not available	Not available	Not available	37.0	36.0	39.0	38.0	38.0	37.0
1970–1973	Not available	Not available	Not available	46.0	44.0	50.0	44.0	40.0	49.0
1974–1976	51.6	51.0	52.6	51.7	50.9	52.9	49.2	50.2	47.4*
1977–1979	51.0	51.2	50.8	51.0	51.5	50.2	51.8	44.7	60.9*
1980–1982	51.7	52.1	51.1	51.1	51.9	49.8	56.3	53.8	60.2*
1982–1985	55.7	56.5	54.3	55.8	56.8	54.2	55.0	54.1	56.4
1986–1988	57.0	57.4	56.3	57.6	58.2	56.8	53.6	52.2	55.5
1988–1991	60.1	60.7	59.2	60.8	61.9	59.2	58.1	55.1	62.3
1992–1994	62.5	62.1	63.0	63.1	62.9	63.4	60.0	58.3	62.3
1995–2000†	63.9	63.9	63.9	63.9	64.1	63.6	63.5	63.5	63.5
1995–2000:									
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*	54.3*
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*	12.8*	33.6‡

Rates for 1960 to 1973 based on End Results data from a series of hospital registries and 1 population based registry, and rates for 1974 to 2000 from SEER 9 areas based on data from population based registries in Connecticut, New Mexico, Utah, Iowa, Hawaii, Atlanta, Detroit, Seattle-Puget Sound and San Francisco-Oakland with overall approximately 12% renal pelvis cancer (source: SEER Program [www.seer.cancer.gov] SEER*Stat Database: Incidence–SEER 9 Regs Public Use, November 2004 Sub [1973 to 2002]. National Cancer Institute, DCCPS, Surveillance Research Program. Cancer Statistics Branch, released April 2005, based on the November 2004 submission).

* SE between 5% and 10%.

† Statistically significant vs 1974 to 1976 ($p < 0.05$).

‡ SE greater than 10%.

yet publicly available. However, this trend was becoming apparent with the appearance of laparoscopic radical nephrectomy and laparoscopic partial nephrectomy in the VA data set in the early 2000s. Laparoscopic partial nephrectomy first appeared in 2001 data and it increased modestly in 2002, while no cases were captured before then (table 10). In academic[8] and community[9] settings laparoscopic techniques are increasingly viewed as the standard of care for patients with kidney cancer.

Recent investigations 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 Health, the VA Outcomes Group and the Leapfrog Group, observed that mortality rates are lower at hospitals where a high volume of major surgery is performed.[10] In addition, individual surgeon volume has an inverse relationship with complication rates.[11] A finding of this research is that mortality rates for certain types of surgery could be decreased if patients elected 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 improve the overall quality of the health care system.

Surgery for kidney cancer was evaluated in this fashion.[12] Not surprisingly, hospitals where high volumes of kidney surgery were performed were found to have lower mortality rates (table 11). 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 in patients undergoing surgery at high volume hospitals.[10] While to our knowledge 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 in 2000 were $401 million, representing a 46% increase since 1994 (table 12). This increase was largely attributable to increasing expenditures for inpatient services. However, hospital outpatient services and physician office visits also increased since 1994, although inconsistently. Inpatient services accounted for about 85% of total RCC expenditures throughout the study period.

Expenditures for RCC by Medicare enrollees 65 years or older amounted to $119 million in 2001, representing an increase of about $26 million since 1992 (table 13). Inpatient services and physician office visits 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 younger than 65 years were $10 million in 2001, representing an increase of $4 million over the 1992 level.

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 14). Average annual expenditures for 35 to 59-year-old patients with employer provided insurance who were treated for RCC were $16,668 compared with $4,513 for similar individuals not treated for the condition. Thus, an incremental cost of $12,155 was associated with an RCC diagnosis. The reasons for the substantial difference were not entirely clear but the excess expenditures may have been 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 was probably attributable to recovery time associated with the surgical management of RCC (table 15). An average of about 7 days was 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, although it must be noted that this finding

TABLE 4. *Inpatient stays by Medicare beneficiaries with RCC as primary diagnosis*

	1992			1995			1998			2001		
	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate
Total all ages	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 younger than 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 or older	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 (0.0–13)	
95–97	20	11 (0.0–31)		20	11 (0.0–31)		0			40	20 (0.0–49)	
98 or older	0			20	11 (0.0–34)		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	Not available	Not available	Not available	20	12 (0.0–35)	0.0	20	6.4 (0.0–19)	6.4	20	4.2 (0.0–12)	4.2
Hispanic	Not available	Not available	Not available	100	25 (3.0–47)	20	160	23 (7.0–38)	23	20	2.5 (0.0–7.4)	2.5
North American native	Not available	Not available	Not available	0		0.0	0		0.0	20	30 (0.0–88)	30
Sex:												
M	5,160	35 (30–39)	35	4,980	33 (29–37)	33	5,020	35 (30–39)	36	4,980	32 (28–36)	33
F	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)	25
West	1,100	20 (15–25)	19	840	16 (11–21)	15	1,320	27 (20–33)	27	1,040	19 (14–24)	18

Unweighted counts multiplied by 20 to arrive at values, rate per 100,000 Medicare beneficiaries in the same demographic stratum, age adjusted rate adjusted to the United States Census derived age distribution of the year under analysis and individuals of other races, unknown race and ethnicity, and other region are included in the total (counts less than 600 should be interpreted with caution) (source: CMS, Medicare Provider Analysis and Review Files, 1992, 1995, 1998 and 2001).

TABLE 5. *Inpatient hospital stays for RCC as primary diagnosis*

	1994			1996			1998			2000		
	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate
Totals	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 or Older	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
Sex:												
M	13,872	25 (23–26)	26	14,828	25 (23–26)	26	15,587	25 (23–27)	26	18,217	28 (26–30)	29
F	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

Rate per 100,000 based on 1994, 1996, 1998 and 2000 population estimates from Current Population Survey, CPS Utilities, Unicon Research Corp. for relevant demographic categories of civilian noninstitutionalized population 35 years or older in the United States, age adjusted rate adjusted to the United States Census derived age distribution of the year under analysis and individuals of other races, and with missing or unavailable race and ethnicity, and missing MSA included in the total (counts may not sum to total due to rounding) (source: HCUP Nationwide inpatient Sample, 1994, 1996, 1998 and 2000).

TABLE 6. *Length of stay for primary RCC diagnosis*

	1994				1996				1998				2000			
	Count	Mean LOS (days)	Median LOS (days)	Max LOS (days)	Count	Mean LOS (days)	Median LOS (days)	Max LOS (days)	Count	Mean LOS (days)	Median LOS (days)	Max LOS (days)	Count	Mean LOS (days)	Median LOS (days)	Max LOS (days)
Totals	23,006	8.1	7	97	24,528	7.2	6	154	26,069	6.7	5	255	30,045	6.4	5	117
Age:																
35–44	1,445	7.1	6	29	1,630	6.2	5	42	1,823	5.6	5	43	1,986	5.5	4	50
45–54	3,287	7.2	6	41	3,675	6.2	5	42	4,405	5.8	5	44	5,474	5.9	5	116
55–64	5,243	7.7	6	68	5,832	6.8	5	154	6,114	6.3	5	83	7,187	5.9	5	84
65–74	7,368	8.3	7	72	7,342	7.4	6	78	7,724	6.8	5	76	8,428	6.5	5	103
75–84	4,675	9	7	97	5,054	8.5	6	111	5,011	7.8	6	255	5,732	7.2	6	64
85 or Older	989	9.8	8	87	995	8.3	6	62	991	8.1	7	66	1,239	8.4	6	117
Sex:																
M	13,872	7.8	6	73	14,828	7	5	154	15,587	8.5	5	75	18,217	6.2	5	87
F	9,134	8.6	7	97	9,700	7.7	6	111	10,483	8.9	5	256	11,818	6.8	5	117
Race/ethnicity:																
White	15,423	8	7	97	16,358	7.2	6	111	16,713	6.5	5	255	18,536	6.2	5	117
Black	1,561	9.8	7	68	1,857	8.2	6	78	1,817	7.5	5	70	2,002	8.1	6	116
Hispanic	710	8.9	7	34	893	8	5	154	1,142	7.5	5	75	1,418	6.8	5	58
Region:																
Northeast	5,206	9.2	7	97	5,709	8.2	6	78	8,256	7.1	5	136	6,627	6.8	5	117
Midwest	5,885	8.1	7	67	6,277	7.2	6	111	8,260	7.1	6	255	7,469	6.2	5	40
South	8,273	7.9	7	67	8,727	7.1	6	154	9,550	6.3	5	83	10,758	6.4	5	103
West	3,643	7	6	72	3,814	6.3	5	53	4,004	6.2	5	71	5,191	6	5	116
MSA:																
Rural	3,318	7.6	6	64	3,048	6.4	5	111	2,807	6.2	5	83	3,042	6.1	5	55
Urban	19,648	8.2	7	97	21,451	7.4	6	154	23,170	6.7	5	255	26,954	6.4	5	117

Adults 35 years or older of other races and with missing or unavailable race and ethnicity, and missing MSA included in the total (counts may not sum to total due to rounding) (source: HCUP Nationwide inpatient Sample, 1994, 1996, 1998 and 2000).

was based on only 20 stays. About 11 hours of work were missed per outpatient visit. There was some variation by region with more work missed per visit in the South and West than in the Northeast and North Central regions.

DISCUSSION

The incidence of kidney cancer increased in the last decade. It will likely accelerate in the future because of the aging of the population in the United States and the increase in comorbid diseases associated with kidney cancer.

The incidence of kidney cancer appears to vary in patients of different races. Black individuals are at increased risk for kidney cancer and a worse prognosis, particularly men younger than 60 years. Trends in the incidence, survival and treatment of kidney cancer in other minorities are poorly characterized. Basic science and epidemiological research endeavors continue to improve the understanding of kidney cancer and they will help explain these variations in the disease and in disease etiology.

As the incidence of kidney cancer continues to increase, particularly that of low stage disease, survival rates are likely to continue to increase. However, the incidence of advanced and metastatic disease is also increasing, which may increase mortality rates. This may be offset by the promise of new targeted therapies for metastatic kidney cancer.

Inpatient care represents the bulk of use of the health care system for kidney cancer. This is largely due to surgery, which remains the standard of care for most stages of the disease. The incidence of metastatic disease is rare in the data sets used in this analysis and, therefore, it could not be assessed in this study. However, the cost of administering immunotherapy for patients with metastatic disease is probably substantial on an individual basis. Similarly as the new targeted therapies are used, the pharmaceutical cost of metastatic kidney cancer treatment is expected to be substantial. Data sets that capture these costs would be helpful for providing a more complete picture of the burden of disease on the health care system.

The burden of outpatient care is expected to increase significantly as the rate of outpatient visits increases, reflecting the increased incidence of curable disease. This results in a higher prevalence and in a larger number of patients on surveillance.

Costs associated with the diagnosis and treatment of kidney cancer totaled approximately $400 million in 2000, placing a considerable burden on the health care system in the United States. Inpatient stays, recovery from surgery and outpatient care keep patients away from other productive activity for substantial amounts of time. However, inpatient stays decreased in the last decade and the widespread adoption of laparoscopic techniques will decrease this costly component of treatment further.

Health care expenditures for RCC were substantial in the general population and in Medicare enrollees 65 years or older. Treatment 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. Almost half of the individuals diagnosed with RCC missed work, and each inpatient stay and outpatient visit resulted in a large amount of work loss.

Opportunities abound for improving our understanding of the burden of kidney cancer in the United States. Tumor registry data, such as those of SEER, are critically important for appreciating racial variations in incidence and survival. Data on minority patients are relatively sparse and greater efforts should be made to capture these numbers and screen populations at risk. A national cancer registry based on the SEER model could further the understanding of kidney cancer by capturing more cases. SEER data could and

TABLE 7. *Inpatient open radical nephrectomy in Medicare beneficiaries with RCC*

	1992			1995			1998			2001		
	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate
Totals	5,520	38,440 (34,873–42,007)		5,200	36,212 (32,688–39,736)		4,640	34,627 (31,015–38,239)		4,580	29,209 (26,019–32,399)	
Age:												
0–64	300	31,250 (17,649–44,851)		380	30,645 (18,842–42,448)		340	25,373 (14,679–36,067)		300	17,241 (9,144–25,339)	
65–69	1,800	44,335 (37,443–51,227)		1,340	36,413 (29,395–43,431)		1,080	33,750 (26,344–41,156)		1,340	31,308 (25,045–37,572)	
70–74	1,280	35,196 (28,132–42,259)		1,420	33,971 (27,497–40,445)		1,140	34,969 (27,571–42,368)		920	26,286 (19,699–32,872)	
75–79	1,340	42,405 (34,615–50,195)		1,160	37,662 (29,923–45,401)		1,000	34,965 (27,054–42,876)		1,260	37,952 (30,493–45,411)	
80–84	700	35,714 (26,058–45,370)		880	43,421 (32,020–54,822)		660	36,667 (26,517–46,816)		660	34,737 (24,986–44,488)	
85–89	100	20,000 (3,148–38,852)		220	44,000 (23,088–64,912)		340	50,000 (32,292–67,708)		100	13,158 (1,898–24,418)	
90–94	20	16,667 (0.0–59,510)		20	16,667 (0.0–59,510)		80	30,769 (1,740–59,799)		0		
Race/ethnicity:												
White	4,740	38,599 (34,738–42,461)	36,966	4,820	37,774 (34,002–41,546)	36,879	4,000	35,211 (31,271–39,151)	33,633	4,100	30,191 (26,730–33,653)	26,801
Black	460	41,071 (27,777–54,366)	37,114	200	18,182 (7,659–28,705)	17,059	380	26,027 (15,719–38,336)	29,203	280	18,919 (9,783–28,055)	19,636
Asian	Not available	Not available	Not available	0	0.0	0.0	20	50,000 (0.0–685,310)	17,000	20	50,000 (0.0–685,310)	17,000
Hispanic	Not available	Not available	Not available	40	22,222 (0.0–58,117)	31,365	120	46,154 (14,799–77,509)	37,910	20	14,286 (0.0–49,242)	11,571
North American native	Not available	Not available	Not available	0			0			0		
Sex:												
M	3,280	39,141 (34,448–43,833)	36,726	3,020	37,940 (33,152–42,727)	37,418	2,820	35,787 (31,033–40,541)	34,839	2,880	32,071 (27,737–36,405)	29,330
F	2,240	37,458 (31,940–42,976)	35,103	2,180	34,063 (28,842–39,283)	33,384	1,820	32,971 (27,390–38,552)	30,721	1,700	25,373 (20,689–30,057)	23,368
Region:												
Midwest	1,320	43,709 (35,706–51,711)	33,865	1,380	42,331 (34,666–49,997)	39,359	1,000	36,765 (28,558–44,972)	34,805	1,380	38,333 (31,162–45,504)	34,843
Northeast	1,320	43,137 (35,201–51,074)	43,416	1,120	42,105 (33,605–50,606)	39,296	860	43,000 (33,127–52,873)	38,096	760	29,231 (21,308–37,154)	24,153
South	2,180	48,879 (42,267–55,491)	45,682	2,140	49,309 (42,604–58,014)	51,216	1,940	41,991 (35,579–48,403)	42,577	1,880	35,606 (29,792–41,420)	33,661
West	680	52,308 (39,835–64,780)	51,480	560	40,580 (28,697–52,462)	44,555	800	56,338 (44,515–68,161)	48,732	540	38,486 (25,257–47,716)	34,044

Unweighted counts multiplied by 20 to arrive at values, rate per 100,000 Medicare beneficiaries with RCC, age adjusted rate adjusted to 2001, individuals of other races, unknown race and ethnicity, and other region included in the total, and no data on ages greater than 95 years (counts less than 600 should be interpreted with caution) (source: CMS, 1992, 1995, 1998 and 2001).

TABLE 8. *Inpatient hospital stays for RCC as primary diagnosis with partial nephrectomy performed*

	1994			1996			1998			2000		
	Count	Rate/100,000 Population (95% CI)	Rate/100,000 Visits for Primary RCC Diagnosis (95% CI)	Count	Rate/100,000 Population (95% CI)	Rate/100,000 Visits for Primary RCC Diagnosis (95% CI)	Count	Rate/100,000 Population (95% CI)	Rate/100,000 Visits for Primary RCC Diagnosis of	Count	Rate/100,000 Population (95% CI)	Rate/100,000 Visits for Primary RCC Diagnosis of (95% CI)
Totals	1,063	0.9 (0.8–1.0)	4,621 (4,169–5,073)	1,448	1.1 (1.0–1.2)	5,895 (5,398–6,393)	1,585	1.2 (1.1–1.3)	6,080 (6,585–6,579)	2,421	1.8 (1.7–1.9)	8,058 (7,825–8,494)
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	*	*	*	199	0.6 (0.4–0.8)	811 (583–1,044)	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	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)	419	1.9 (1.6–2.2)	1,607 (1,346–1,868)	658	2.8 (2.5–3.1)	2,190 (1,954–2,428)
65–74	406	2.3 (2.0–2.6)	1,765 (1,543–1,982)	418	2.3 (2.0–2.8)	1,704 (1,500–1,908)	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	215	2.2 (1.9–2.6)	935 (800–1,074)	280	2.6 (2.3–3.0)	1,142 (995–1,288)	202	1.8 (1.5–2.1)	775 (637–917)	312	2.7 (2.3–3.1)	1,038 (882–1,195)
Sex:												
M	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)	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)
F	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)	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	722	0.8 (0.7–0.8)	3,138 (2,804–3,477)	962	1.0 (0.9–1.0)	3,922 (3,643–4,305)	1,033	1.0 (0.9–1.1)	3,963 (3,641–4,388)	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)
Region:												
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)	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)
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)	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)
South	443	1.1 (1.0–1.2)	1,928 (1,708–2,139)	586	1.3 (1.2–1.4)	2,389 (2,149–2,630)	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	*	*	*	160	0.6 (0.5–0.7)	652 (510–795)	232	0.8 (0.7–1.0)	890 (729–1,051)	446	1.5 (1.3–1.7)	1,484 (1,278–1,691)
Urban MSA	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)	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)

Rate per 100,000 based on 1994 to 2000 population estimates from Current Population Survey, CPS Utilities, Unicon Research Corp. for relevant demographic categories of adult civilian noninstitutionalized population 35 years or older in the United States, rate per 100,000 adult 35 years or older visits with partial nephrectomy performed based on estimated number of visits for RCC in HCUP National Inpatient Sample 1994 to 2000, individuals of other races, and with missing or unavailable race and ethnicity, and missing MSA Included in the total, and values for ages 85 years or older, Hispanic race/ethnicity and rural MSA do not meet reliability or precision standards (counts may not sum to total due to rounding) (source: HCUP Nationwide Inpatient Sample, 1994, 1996, 1998 and 2000).

* Value does not meet reliability or precision standard.

TABLE 9. *Inpatient open partial nephrectomy in Medicare beneficiaries with RCC*

	1992			1995			1998			2001		
	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate	Count	Rate (95% CI)	Age Adjusted Rate
Totals	360	2,507 (1,361–3,653)		320	2,228 (1,146–3,311)		400	2,985 (1,693–4,277)		460	2,934 (1,750–4,117)	
Age:												
0–64	20	2,083 (0.0–6,274)		0			60	4,478 (0.0–9,560)		40	2,299 (0.0–5,511)	
65–69	140	3,448 (917–5,980)		100	2,717 (346–5,089)		60	1,875 (0.0–4,000)		140	3,271 (869–5,673)	
70–74	60	1,676 (0.0–3,575)		120	2,871 (588–5,153)		80	2,454 (54–4,854)		80	2,286 (50–4,522)	
75–79	120	3,797 (784–6,810)		100	3,247 (416–6,078)		100	3,497 (449–6,544)		160	4,819 (1,527–8,111)	
80 or Older	20	1,020 (0.0–3,046)		0			100	5,556 (731–10,380)		40	2,105 (0.0–5,045)	
Race/ethnicity:												
White	300	2,443 (1,218–3,668)	1,890	280	2,194 (1,055–3,334)	1,648	320	2,817 (1,452–4,182)	2,293	440	3,240 (1,905–4,575)	3,115
Black	20	1,786 (0.0–5,364)	1,700	40	3,636 (0.0–8,744)	3,237	60	4,110 (0.0–8,773)	4,288	20	1,351 (0.0–4,045)	1,425
Asian	Not available	Not available	Not available	0			0			0		
Hispanic	Not available	Not available	Not available	0			0			0		
North American native	Not available	Not available	Not available	0			0			0		
Sex:												
M	300	3,580 (1,794–5,366)	3,084	160	2,010 (625–3,395)	1,566	300	3,807 (1,909–5,705)	4,001	200	2,227 (857–3,597)	2,242
F	80	1,003 (0.0–2,140)	748	160	2,500 (780–4,220)	1,864	100	1,812 (228–3,395)	1,396	260	3,881 (1,802–5,959)	3,138
Region:												
Midwest	60	1,987 (0.0–4,238)	1,425	120	3,681 (760–6,602)	2,652	140	5,147 (1,386–8,908)	4,236	120	3,333 (686–5,981)	2,750
Northeast	100	3,268 (419–6,117)	2,263	60	2,256 (0.0–4,812)	1,663	60	3,000 (0.0–6,402)	1,928	180	6,923 (2,501–11,345)	5,901
South	160	3,587 (1,128–6,047)	2,938	100	2,304 (292–4,316)	1,795	80	1,732 (37–3426)	1,718	160	3,030 (949–5,112)	3,068
West	40	3,077 (0.0–7,389)	4,644	40	2,899 (0.0–8,958)	2,250	120	8,451 (1,820–15,081)	11,585	0		

Unweighted counts multiplied by 20 to arrive at values, rate per 100,000 Medicare beneficiaries with RCC, age adjusted rate adjusted to 2001 and individuals of other races, unknown race and ethnicity, and other region included in the total (counts less than 600 should be Interpreted with caution) (source: CMS, 1992, 1995, 1998 and 2001).

TABLE 10. *VA users with laparoscopic partial nephrectomy for RCC in 1998 to 2003*

	2001 Count	2002 Count	2003 Count
Totals	4	12	6
Age adjusted totals	4	9	4
Age:			
Younger than 25	0	0	0
25–34	0	0	0
35–44	0	1	0
45–54	4	3	1
55–64	0	4	2
65–74	0	2	1
75–84	0	0	0
85 or Older	0	1	0
Sex:			
M	4	12	6
F	0	0	0
Race/ethnicity:			
White	2	10	3
Black	0	0	1
Hispanic	1	0	0
Other	0	0	1
Unknown	1	2	1
Insurance status:			
No insurance/self-pay	4	10	5
Medicare	0	2	0
Medicaid	0	0	0
Private insurance/health maintenance organization	0	0	1
Other	0	0	0
Unknown	0	0	0
Region:			
Eastern	2	0	2
Central	0	0	1
Southern	2	10	3
Western	0	2	0

Rate per 100,000 veterans using the VA system, no count for 1998 to 2000 and no rates meet reliability or precision standard (source: Inpatient and Outpatient Files, VA Information Resource Center, VA Health Services Research and Development Service Resource Center).

TABLE 12. *RCC expenditures by service site*

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

Source: NAMCS, National Hospital and Ambulatory Medical Care Survey, HCUP and Medical Expenditure Panel Survey, 1994, 1996, 1998 and 2000.

should be improved by separating upper tract transitional cell carcinoma from RCC since these diseases behave differently. Current International Classification of Diseases, 9th revision 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 many aspects of the burden of RCC. For example, the incidence of renal insufficiency in patients undergoing radical rather than partial nephrectomy could be evaluated, as could the role of end stage renal disease in the increased incidence of kidney cancer.

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

The data sets used in this analysis do not capture standard immunotherapy care or new targeted therapies (tyrosine kinase inhibitors) for patients with metastatic disease. These treatments are quite costly and until recently they had a relatively small impact on survival. The era of targeted therapy is just beginning and the role of cytoreduc-

TABLE 11. *Mortality rates and length of stay by nephrectomy type in 1993 to 1997*[12]

		Hospital Nephrectomy Vol (No. cases/yr)			
	Totals	Low (less than 15)	Medium (15–33)	High (greater than 33)	p Value
		% Mortality			
All nephrectomy types	1.39	1.60	1.49	1.04	0.017
Partial nephrectomy	0.85	2.25	0.57	0.36	0.018
Radical nephrectomy	1.38	1.46	1.52	1.10	0.137
Nephroureterectomy	1.68	2.05	1.66	1.08	0.312
		Days stay (95% CI)			
All nephrectomy types	7.80 (7.71–7.89)	7.85 (7.71–7.99)	7.83 (7.67–7.99)	7.70 (7.54–7.86)	0.350
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)	0.001
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)	0.837
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)	0.571

TABLE 13. *Medicare beneficiary expenditures for RCC treatment*

Service Type	$ Expenditures (% total) 1992	1995	1998	2001
65 or Older:				
Hospital outpt	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)
Inpt	82,586,560 (88.1)	85,331,180 (85.6)	87,541,560 (79.7)	96,849,520 (81.2)
Totals	93,793,700	99,675,900	109,831,800	119,298,480
Younger than 65:				
Hospital outpt	597,780 (9.6)	802,280 (38.3)	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)
Inpt	5,032,500 (80.7)	— (0.0)	8,351,640 (87.6)	8,020,320 (80.8)
Totals	6,234,720	2,211,080	9,539,020	9,920,320

Source: CMS, 1992, 1995, 1998 and 2001.

tive nephrectomy is no longer clear in the context of these agents. Clinical trials could be designed to address the question of cytoreductive nephrectomy in the context of metastatic disease.

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 for standard immunotherapy with a marginal survival benefit. In addition, the data sets used in this analysis do not capture newer, less invasive therapies for localized disease, such as radio frequency ablation and cryotherapy. It would be useful to understand the degree of adoption of these thermal therapies along with their costs and effectiveness.

Surgery for kidney cancer is currently in a period of transition, in which open partial nephrectomy as well as laparoscopic nephrectomy and laparoscopic partial nephrectomy are emerging as new standards of care in their appropriate situations. Laparoscopic radical nephrectomy may be performed for the sake of decreased surgical morbidity when open or laparoscopic partial nephrectomy is more appropriate. In future studies it will be important to ascertain the use of these techniques and the role of academic training centers in the dissemination of these techniques for the wider use of these improvements to manage kidney cancer. Importantly the evolution of partial nephrectomy as the new standard of care for small kidney tumors should be followed as a quality of care issue.

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 data sets used in this analysis for length of stay will begin to reflect the trend toward laparoscopic techniques. Currently equipment costs for laparoscopic surgery somewhat offset the benefits of shorter hospitalization but with time these costs will likely decrease.

However, the compelling case for laparoscopic techniques for kidney cancer treatment could best be addressed by looking at disability time and costs in data sets of large disability insurance carriers. As shorter hospitalization time and earlier return to work are increasingly recognized, payors should reimburse these procedures at a higher rate. Third party payors would 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.[13]

Outcomes research in quality of care is a growing field that will have an increasingly powerful role in health care delivery in the future. More effort should be made and more support should be offered for outcomes studies of the

TABLE 14. *Estimated annual expenditures of privately insured employees with and without RCC medical claim in 2002*

	$ Annual Expenditures/Pt Without RCC (394,175 pts)			$ Annual Expenditures/Pt With RCC (386 pts)		
	Medical	Prescription Drugs	Totals	Medical	Prescription Drugs	Totals
All	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

Primary beneficiaries 35 to 64 years old with provided insurance who were continuously enrolled in 2002, estimated annual expenditures derived from multivariate models controlled 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 and co-insurance/co-payments) and binary indicators for 28 chronic disease conditions, and predicted expenditures for those 60 to 64 years old omitted due to small sample size (source: Ingenix, 2002).

TABLE 15. *Annual work loss of individuals treated for RCC in 1999*

	No. Workers[a] (% missing work)	Av Hrs Work Absence (95% CI)		
		Inpt	Outpt	Totals
Totals	52 (48)	40.3 (15.6–65.1)	56.3 (0–116.1)	96.6 (24.4–168.8)
Age:				
18–29	1 (100)	180.9 (not available)	180.9 (not available)	361.8 (not available)
30–39	2 (50)	48.0 (0–657.9)	52.0 (0–712.7)	100.0 (0–1370.6)
40–49	9 (78)	26.8 (0–73.5)	101.7 (0–301.6)	128.5 (0–374.0)
50–64	40 (40)	39.5 (9.3–69.6)	43.1 (0–111.2)	82.6 (1.5–163.6)
Sex:				
M	42 (48)	40.5 (11.5–69.5)	60.9 (0–134.7)	101.3 (13.8–188.9)
F	10 (50)	39.7 (0–91.7)	36.9 (0–188.9)	76.6 (0–179.9)
Region:				
Northeast	7 (29)	73.1 (0–239.4)	3.4 (0–11.80)	76.6 (0–251.2)
North Central	12 (42)	56.4 (0–119.2)	26.4 (0–62.9)	82.8 (0–165.9)
South	21 (52)	24.9 (2.2–47.5)	78.3 (0–211.2)	103.2 (0–252.9)
West	5 (40)	37.1 (0–14.00)	163.9 (0–600.9)	200.9 (0–740.9)
Unknown	7 (71)	28.6 (0–61.1)	17.1 (0–53.0)	45.7 (0–110.6)

Individuals with an inpatient or outpatient claim for RCC 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, and inpatient and outpatient including absences that started or stopped the day before or after a visit (source: Marketscan Health and Productivity Management, 1999).

treatment of kidney cancer aimed at improving outcomes for patients and providing high quality care in all regions of the country. A 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.

CONCLUSIONS

Kidney cancer places a significant burden on the health care system in the United States. Trends in incidence, costs and resource use appear to have increased in the last 2 decades. Important variations in the racial distribution of the disease and in survival mandate further research on the treatment of this disease. Surgical techniques and medical therapies for kidney cancer are evolving rapidly and they will likely affect the burden of this disease on our society in the future.

Abbreviations and Acronyms

CMS = Centers for Medicare and Medicaid Services
DCCPS = Division of Cancer Control and Population Sciences
HCUP = Health Care Cost and Utilization Project
MSA = metropolitan statistical area
NAMCS = National Ambulatory Medical Care Survey
RCC = renal cell carcinoma
SEER = Surveillance, Epidemiology and End Results Program
VA = Veterans Affairs

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EDITORIAL COMMENT

Using various national databases these authors catalogued clinical trends and health care resource use for patients with kidney cancer between 1992 and 2001. They report an increasing incidence of all stages of kidney cancer, particularly for stage T1 and in black men younger than 60 years. In-

creased incidental detection coupled with a true increase in incidence, possibly secondary to now prevalent medical comorbidities such as hypertension and obesity, requires costly surgical interventions and hospitalization. In 2000 an estimated $401 million, representing a 46% increase from 1994, was spent for the care of patients with kidney cancer. The authors also report decreased length of hospitalization, which is a trend seen in other surgical diseases, increased use of partial nephrectomy and the early integration of laparoscopic surgery.

Exciting new insights and discoveries, of which some are already being integrated into clinical practice but are not yet reflected in these databases, should favorably impact future outcomes and cost analyses. Renal cortical tumors are a family of diseases with diverse histology, cytogenetics and variable metastatic potential. Approximately 20% of such tumors are benign, 25% are indolent with limited metastatic potential and 54% are the conventional clear cell carcinoma responsible for 90% of metastases. Active research designed to preoperatively distinguish the benign and indolent tumors from the clear cell variant using G250 positron emission tomography,[1] and improved accuracy for percutaneous biopsies using molecular probes and immunohistochemical markers should allow the rational surveillance of patients with small nonclear cell tumors, particularly if they are elderly or comorbidly ill, and the confident further expansion of kidney sparing techniques. New concerns for the development or worsening of preexisting chronic kidney disease (estimated glomerular filtration rate less than 60 ml per minute per 1.73 m^2),[2] and its associated adverse events of cardiovascular disease, hospitalization and death[3] render radical nephrectomy by open or laparoscopic techniques an undesirable operation for the small renal mass. As this important information is disseminated through the urological community, it is hoped that there will be an increase in partial nephrectomy for small renal tumors from the current rate of less than 10% to greater than 70%, as is the case at select American medical centers, a trend that only education and expert training can reverse.[4]

Lastly, for the 25% to 30% of patients who present with or later have metastatic renal cancer the recent Food and Drug Administration approval of the new targeted therapies sutintinib and sorafinib has increased survival, lead to disease regression in previously treated and treatment naïve patients, and now represent new standards of care.[5] The role of the surgeon is likely to expand to consolidate partial responses as these agents are studied in the neoadjuvant and adjuvant settings.

Taken together the future is more promising than ever as we improve patient survival by avoiding overtreatment of small tumors with limited metastatic potential, prevent or delay cardiovascular toxicities as a result of such overtreatment by radical nephrectomy and prolong survival for patients with metastatic disease with combinations of targeted agents and advanced surgical interventions.

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