DATA REPORT on Kidney and Renal Pelvic Cancer in Massachusetts

The Massachusetts Cancer Registry, Massachusetts Department of Public Health - June 2011

PURPOSE & SUMMARY

This report provides descriptive and analytic information on the incidence of kidney and renal pelvic cancer in Massachusetts residents, using data from the Massachusetts Cancer Registry (MCR). Throughout most of the report, the statistics will refer to cancer of the kidney and renal pelvis and the acronym KRPC will be used. When statistics are specific to either the kidney or renal pelvis, it will be indicated as such. KRPC cancer incidence rates increased significantly from 1998 to 2007 among both males and females, with the incidence rates of males being twice those of females. This report will explore in detail the epidemiology behind these ten year trends along with more recent data from the 2003 to 2007 MCR annual report. Staging data will be limited to 2001 to 2007 due to the changes in staging criteria beginning in 2001. This report also examines kidney cancer mortality rates using data from the Massachusetts Registry of Vital Records and Statistics.

SOURCES OF INCIDENCE & MORTALITY DATA

The Massachusetts Cancer Registry (MCR): All Massachusetts incidence data are provided by the Massachusetts Cancer Registry, which is part of the Massachusetts Department of Public Health (MDPH). The MCR is a population-based cancer registry that began collecting reports of newly-diagnosed cancer cases in 1982. The MCR collects reports of newly diagnosed cancer cases from health care facilities and practitioners throughout Massachusetts. Facilities reporting to the MCR in 2007 included 69 Massachusetts acute care hospitals, 7 radiation centers, 3 endoscopy centers, 4 surgical centers, 14 independent laboratories, 1 medical practice association, 1 radiation/oncology center and approximately 500 private practice physicians. Reports from dermatologists' offices and dermatopathology laboratories, particularly on cases of melanoma, have only been collected by the MCR since 2001. Reports from urologists' offices have only been collected by the MCR since 2002. Currently, the MCR collects information on *in situ* and invasive cancers and benign tumors of the brain and associated tissues. The MCR does not collect information on basal and squamous cell carcinomas of the skin. The MCR also collects information from reporting hospitals on cases diagnosed and treated in staff physician offices when this information is available. Not all hospitals report this type of case, however, and some hospitals report such cases as if the patients had been diagnosed and treated by the hospital directly. Collecting these types of data makes the MCR's overall case ascertainment more complete. Some cancer types that may be reported to the MCR in this manner are melanoma, prostate, colon/rectum, and oral cancers. The MCR also identified and included cancers noted on death certificates that were not previously reported to the MCR.

The North American Association of Central Cancer Registries (NAACCR) has estimated that MCR case ascertainment is over 95% complete through 2007. The Massachusetts cancer cases presented in this report are primary cases of invasive KRPC that were diagnosed

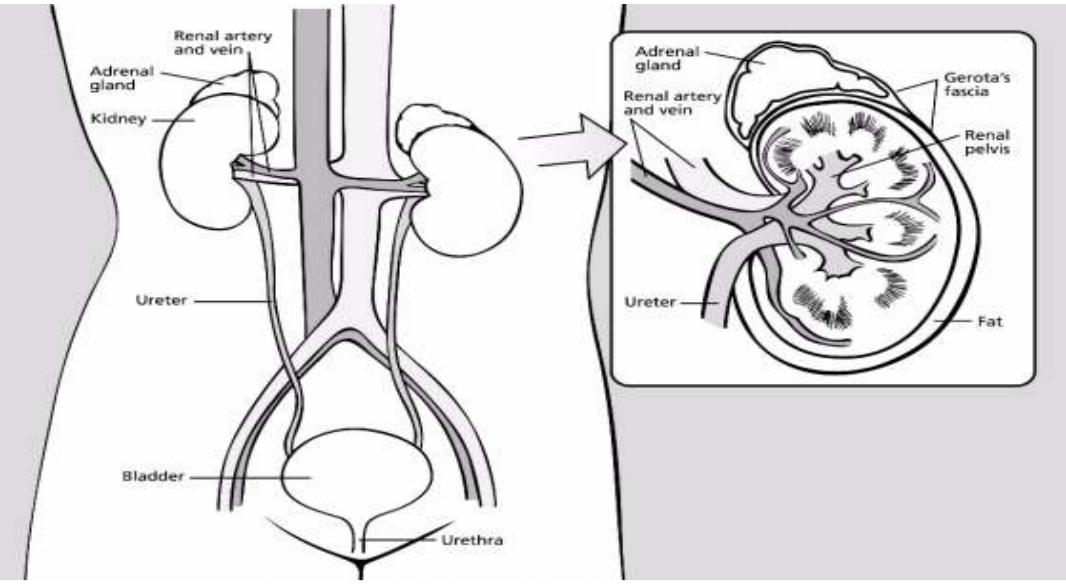
among Massachusetts residents, unless noted otherwise. A primary case of KRPC means that the cancer originated in the kidney gland or the renal pelvis.

Surveillance, Epidemiology and End Results (SEER): National data on cancer incidence are from the National Cancer Institute's SEER Program, an authoritative source on cancer incidence in the United States that collects and publishes data from registries in selected areas. The national cancer incidence data in this report include malignant cases from the 13 SEER areas (including Atlanta, Connecticut, Detroit, Hawaii, Iowa, New Mexico, San Francisco-Oakland, Seattle-Puget Sound, Utah, Los Angeles, San Jose-Monterey and Alaska, and rural Georgia). SEER rates are presented per 100,000 persons and are age-adjusted to the 2000 United States standard population.

Massachusetts Registry of Vital Records and Statistics: Massachusetts death data were obtained from the MDPH's Registry of Vital Records and Statistics, which has legal responsibility for collecting reports of deaths of Massachusetts residents. The national mortality data are from the National Center for Health Statistics and include the entire United States.

THE EPIDEMIOLOGY OF KIDNEY CANCER

The Kidney and Renal Pelvis and Cancer[1]:



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According to the American Cancer Society's (ACS) guide to kidney cancer, 'the kidneys are a pair of bean-shaped organs, each about the size of a fist and weighing about 4 to 5 ounces. The kidney's main job is to filter the blood to remove excess water, salt, and waste products. These substances become urine, which is made by the kidneys. Urine travels to the bladder through the ureters. The place where the ureter meets the kidney is called the renal pelvis. The kidneys also help to make sure that the body has enough red blood cells through a hormone called erythropoietin, which tells the bone marrow to make more blood cells.'[1]

Risk Factors for Kidney Cancer:

Smoking – According to the ACS, "smoking increases the risk of developing KRPC, with an increased risk related to how much a person smokes. The risk drops if you stop smoking, but it takes many years to get to the level of someone who never smoked."[1]

Obesity – According to the ACS, "people who are overweight have a higher risk of developing KRPC, with some doctors thinking that obesity is a factor in 20% of people who get KRPC." The obesity may cause hormonal changes that lead to this cancer.[1]

Workplace Exposure – According to the ACS, "many studies have suggested that workplace exposure to chemicals such as asbestos, cadmium, some herbicides, benzene, and organic solvents, particularly trichloroethylene increases the risk of KRPC."[1]

Genetic Risks:

> **Von Hippel-Lindau (VHL) Disease** – This is a disease that runs in certain families and is caused by mutations in the VHL gene. Its prevalence is approximately 1 case per 36,000 newborns.[2] It results in development of tumors and cysts in different parts of the body and an increased risk in the development of clear cell renal carcinoma (a type of KRPC), especially at a younger age.[1,3] Renal cancer occurs in 25-45% of patients with VHL. With the inclusion of cystic lesions, this figure jumps to over 60%. The renal tumors tend to be multifocal and bilateral.[4]
>
> **Hereditary Leiomyoma-Renal Cell Carcinoma** – People with this condition, linked to the changes in fumarate (FH) gene, develop smooth muscle tumors or fibroids of the skin and uterus (in women) and have a higher risk for developing papillary renal cell cancers.[1] The renal malignancies that develop are often metastatic at presentation and are a significant cause of mortality.[4]
>
> **Birt-Hogg-Dubé (BHD) Syndrome** – People with this condition, linked to the folliculin gene (FLCN), develop small benign skin tumors on the face, neck, and upper trunk. People with this syndrome have a seven-fold risk of developing kidney cancer. There is no specific kidney cancer type (histology) associated with this syndrome as BHD patients develop all types.[4]

Family history – The ACS states that "people with a strong family history of renal cell cancer (without the inherited conditions) also have a 2 to 4 times increased risk of developing this cancer. The risk is highest in siblings of those with the cancer, due to either shared genes, common exposures, or both"[1]

High Blood Pressure – High blood pressure increases the risk of kidney cancer due to either the condition itself, the medication such as diuretics used to treat it, or both.[1]

Sex – Males are twice as likely as females to develop renal cell carcinoma. Higher smoking rates and occupational exposure may be contributing factors to this difference.[1]

Dialysis – People with advanced kidney disease who need dialysis, a treatment which removes toxins from the body, are at a higher risk of developing renal cell carcinoma. [1,4]

Race – Black, non-Hispanics (NHs) have a slightly higher rate of renal cell cancer, although it is not known why.[1] According to the National Kidney Disease Education Program, blacks have disproportionate amounts of high blood pressure and kidney failure leading to dialysis compared to the US population as a whole.[5]

Histological Types of Kidney and Renal Pelvis Cancer:

There are several types of kidney and renal pelvis cancer, based on histology codes (see Technical Notes). This section provides a description of these histological types and a later section in this report provides more detail on the percentages of the different histologies among KRPC cases in Massachusetts from 1998 to 2007.

Renal Cell Carcinoma of the kidney is the most common, accounting for 90% of kidney cancers. There are four main types of renal cell carcinoma (RCC).[1,6]

> **Clear Cell RCC** – This is the most common form of kidney cancer and represents up to 75% of RCC cases. Clear cell RCC is the cell type associated with von Hippel Lindau gene mutation in hereditary kidney cancer. Additionally, approximately 70% of non-hereditary cases of clear cell RCC also have a VHL mutation.[1,6]
>
> **Papillary RCC** – This is the second most common form of kidney cancer, making up approximately 15% of RCC cases. There is an increased incidence of papillary RCC among blacks for this subtype[1,6]. From 1998 to 2007 in Massachusetts, 7.5% of all KRPC were papillary RCCs. Among black, NHs, however, 16.4% of all KRPC were papillary RCCs.
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> **Chromophobe RCC** – This form of kidney cancer represents approximately 5% of RCC cases.[1,6]
>
> **Collecting Duct RCC** – This is a very rare and aggressive form of kidney cancer that represents less than 1% of cases. It is usually metastatic at the time of diagnosis.[1,6]

Transitional Cell Carcinomas represent about 5 to 10% of KRPC cancers. These tumors do not start in the kidney itself, but in the renal pelvis. [1,6] Studies have shown these cancers to be related to cigarette smoking and workplace exposures to certain cancer-causing chemicals.[1] Of the 580 renal pelvis cancer cases diagnosed from 1998 to 2007, 95% were transitional cell carcinomas.

Wilms tumors are also known as nephroblastomas and are almost always found in children. This type of cancer is very rare among adults and may be the result of genetic mutations in

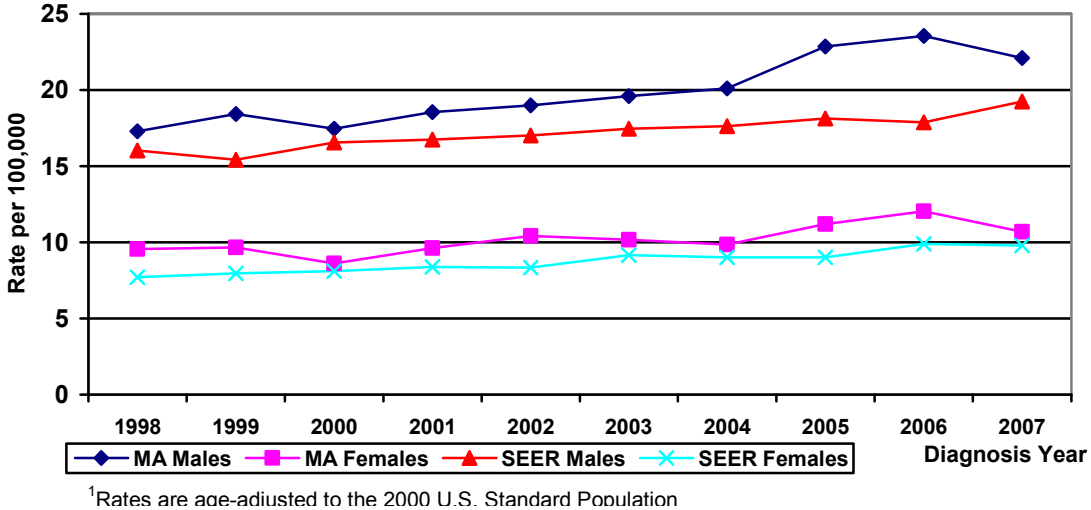
the embryo affecting the development of mature kidney cells. Most of the Wilms tumors, however, do not appear to be the result of inherited syndromes causing genetic mutations.[1] Of the 89 cases diagnosed in Massachusetts from 1997 to 2007, 75% were 5 and younger and 90% were 10 and younger.

Renal Sarcomas are a rare type of kidney cancer representing less than 1% of all kidney tumors. They begin in the blood vessels or connective tissue of the kidney.[1]

KRPC Incidence Trends:

From 2003 to 2007 in Massachusetts, there were 3341 cases of KRPC among males, with an age-adjusted incidence rate of 21.7 per 100,000, making it the 7th most common cancer among males. There were 2069 cases among females, with an age-adjusted rate of 10.7, making it the 11th most common cancer among females. From 1998 to 2007, the incidence of male KRPC cases (N=5954) in Massachusetts increased with a statistically significant annual percent change (APC) of 3.4% compared to an APC of 2.0% nationally (SEER). For female incident cases (N=3855) in Massachusetts, there was a statistically significant increase of cases with an APC of 2.4% compared to a national APC of 2.8% (Figure 1).

Figure 1. Annual Age Adjusted Kidney and Renal Pelvis Cancer Incidence Rates[1] by Sex and Year of Diagnosis, Massachusetts vs SEER, 1998-2007



[1]Rates are age-adjusted to the 2000 U.S. Standard Population
Data Source: Massachusetts Cancer Registry

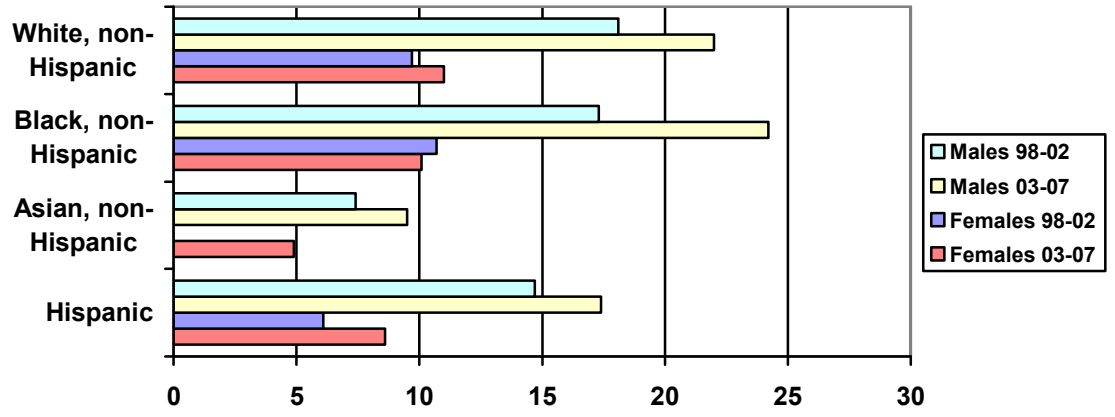
KRPC Incidence by Race/Ethnicity:

Due to the small numbers of cases among black, NHs, Asian, NHs, and Hispanics, incidence trends by year from 1998 to 2007 were not analyzed. The combined KRPC incidence rates for 1998 to 2002 and for 2003 to 2007 were compared among the four racial/ethnic groups (Figure 2).

Among males for both time periods, only Asian, NHs had a significantly lower rate of KRPC compared to the other three racial/ethnic groups. While the incidence rate for black, NH males increased the most, from 17.3/100,000 to 24.2/100,000, it was not a statistically significant increase. This may be partly due to the small number of cases.. The increase among white, NH males, while smaller (18.1 to 22/100,000), was statistically significant.

Among females for the period 2003 to 2007, Asian, NHs had a significantly lower rate of KRPC compared to white and black, NHs, but not compared to Hispanics. From 1998 to 2002, there were too few Asian, NH female cases for analysis and white, NH females had significantly higher rates compared to black, NHs and Hispanics. There were no statistically significant changes in incidence rates among the female racial/ethnic groups between the two time periods.

Figure 2. Age-Adjusted Kidney and Renal Pelvis Cancer Incidence Rates[1] by Sex and Race/Ethnicity, Massachusetts, 1998-2002 and 2003-2007



[1]Rates are age-adjusted to the 2000 U.S. Standard Population
Data Source: Massachusetts Cancer Registry

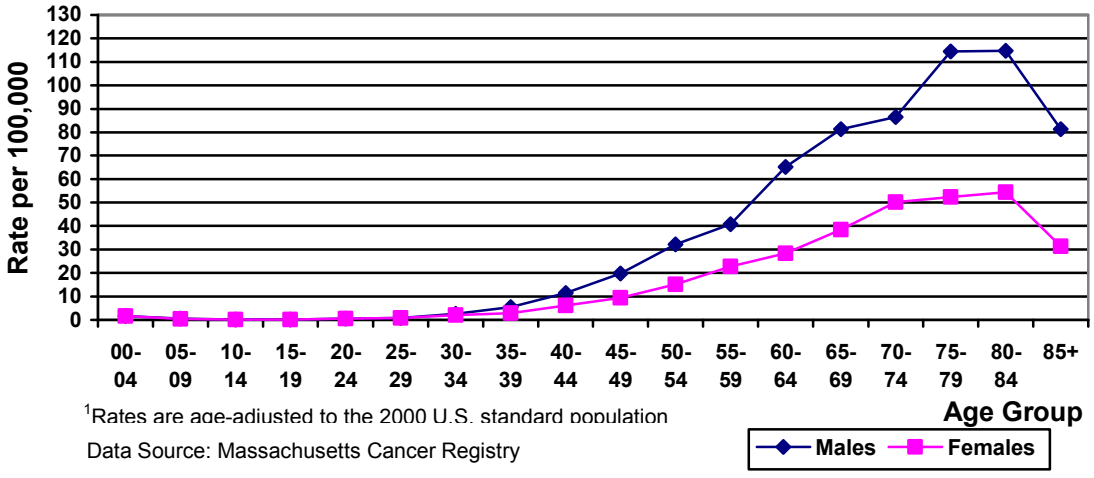
Males:	1998-2002	2003-2007	Females:	1998-2002	2003-2007
White NH	2358	3032	White NH	1644	1887
Black NH	88	147	Black NH	71	83
Asian NH	24	44	Asian NH	<5*	24
Hispanic	57	98	Hispanic	33	61

*-cases too few for rate calculation.

KRPC Incidence by Age:

For the period 2003-2007, the median age at kidney cancer diagnosis was 64 for males and 67 for females. Rates of KPCR peaked at 75-84 years of age for both females and males during this same time period (Figure 3). Males had higher rates than females beginning at age 35 and differences widened in later ages.

Figure 3. Age-Specific Kidney and Renal Pelvis Cancer Incidence Rates[1] By Sex, Massachusetts, 2003-2007 (N=5414)



[1]Rates are age-adjusted to the 2000 U.S. standard population

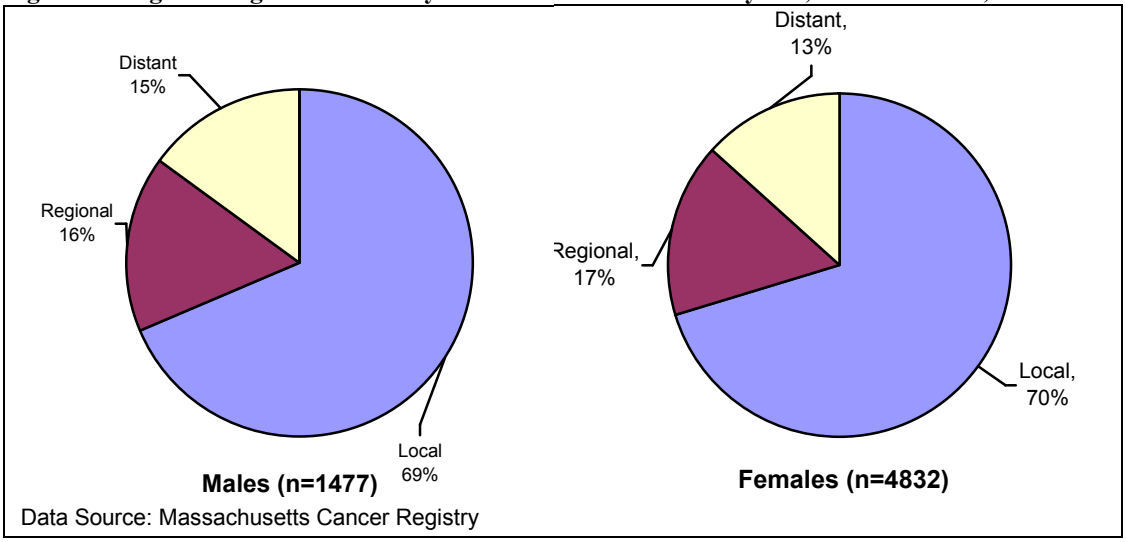
Data Source: Massachusetts Cancer Registry

KRPC Stage at Diagnosis:

Staging data for KRPC were analyzed from 2001 to 2007 by race/ethnicity and sex. These years were selected because staging criteria changed in 2001 and are most comparable during this period. Comparisons of 2001 data to 2007 showed a significantly increased percentage of localized cancers, from 66.3% in 2001 to 71.5% in 2007, accompanied by a significant decrease in distant cancers from 17.5% to 13.3% and a slight (non-significant) decrease in regional cancers from 16.2% to 15.2%. Trends in stage at diagnosis by histological type are described in the following section.

Sex: There were no significant differences in stage at diagnosis of KRPC between males and females (Figure 4).

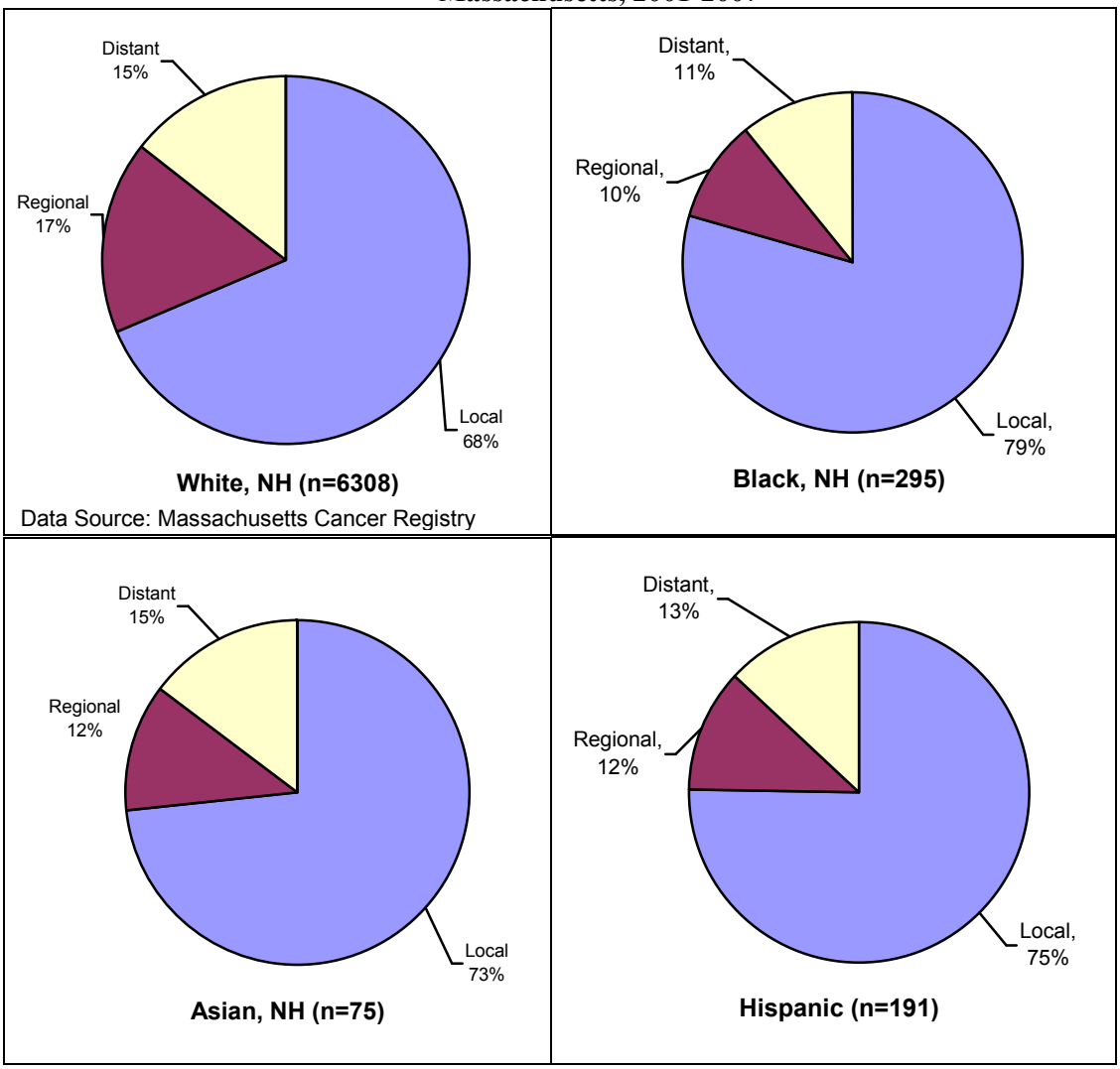
Figure 4. Stage at Diagnosis of Kidney and Renal Pelvis Cancer by Sex, Massachusetts, 2001-007



Data Source: Massachusetts Cancer Registry

Race/Ethnicity. When comparing stage at diagnosis, there were no significant differences between white, NHs and Asian, NHs and between white, NHs and Hispanics. Black, NHs, however, were significantly more likely to be diagnosed at an earlier stage of disease compared to white, NHs. (Figure 5).

Figure 5. Stage at Diagnosis of Kidney and Renal Pelvis Cancer by Race/Ethnicity, Massachusetts, 2001-2007

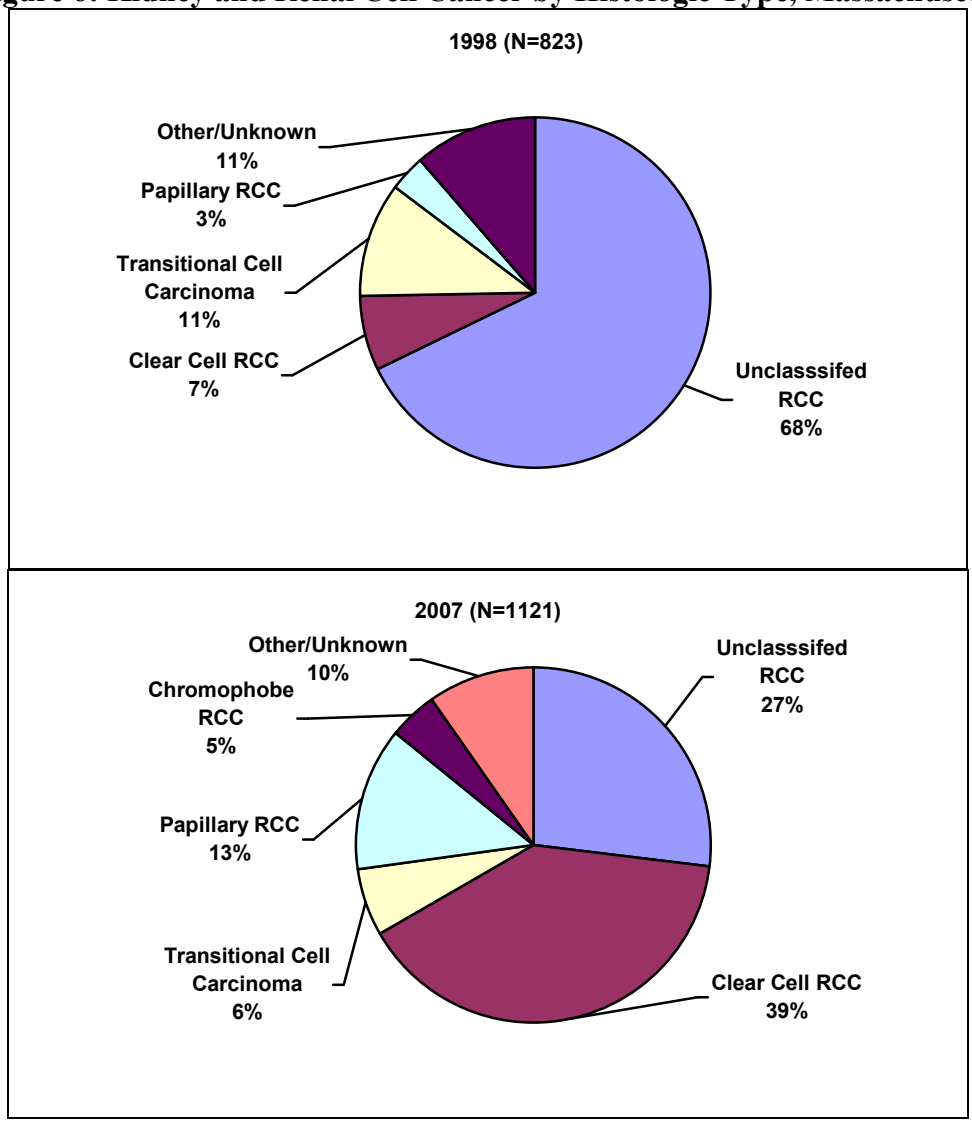


Data Source: Massachusetts Cancer Registry

KRPC Incidence by Histological Type:

The predominant KRPC histological type in 1998 was unclassified renal cell carcinoma, representing 68% of the cases (Figure 6). This type fell to 27% of the cases by 2007 (Figure 6). At the same time, this type decreased, clear cell renal cell carcinoma increased from 7% to 39%. This is most likely due to the better classification of renal cell carcinomas. The percentage of papillary renal cell carcinomas increased from 3% to 13% and transitional cell carcinomas decreased from 11% to 6%.

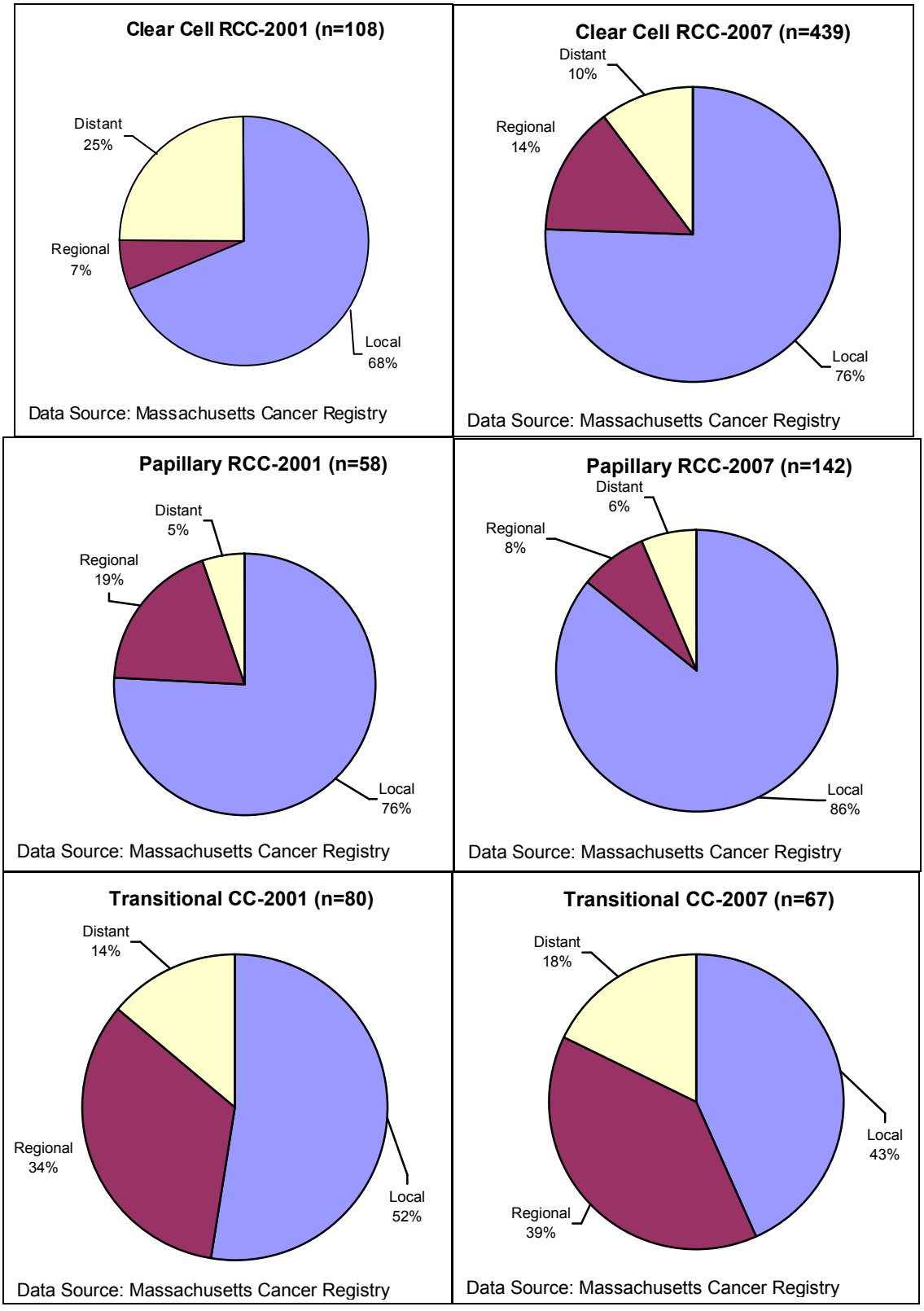
Figure 6: Kidney and Renal Cell Cancer by Histologic Type, Massachusetts



*- Other includes RCC sarcomatoid, granular cell carcinoma, and Wilms Tumor. Unknown includes unknown neoplasm and unknown carcinoma type. Data Source: Massachusetts Cancer Registry

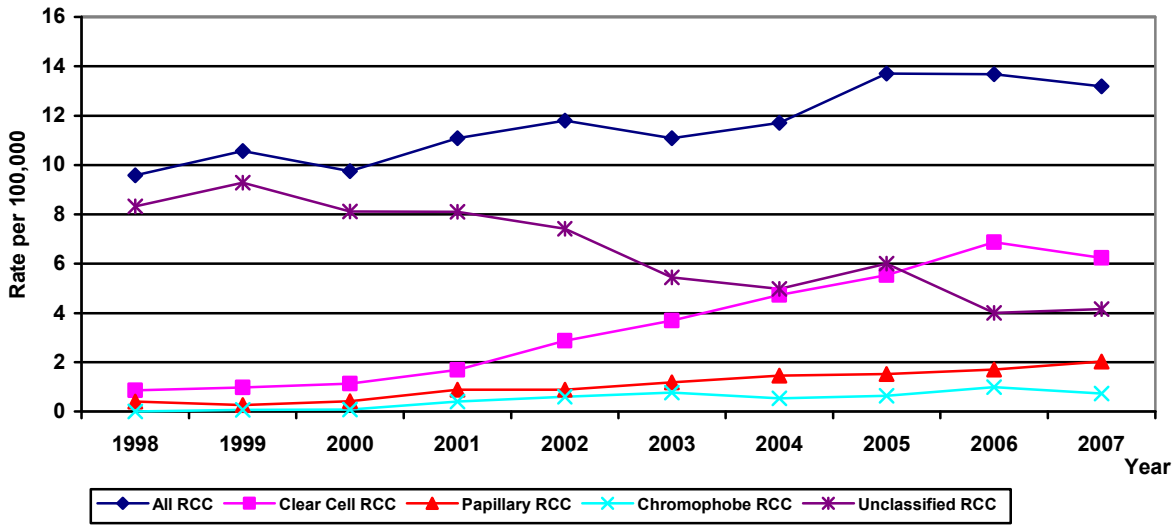
KRPC Histological Type and Stage at Diagnosis: As described in the previous section, the proportion of KRPC diagnosed at the local stage was significantly higher in 2007 compared to 2001. When comparing stage at diagnosis in 2001 to 2007, the proportion of both clear cell and papillary RCCs diagnosed at the local stage was significantly higher in 2007 with significantly higher proportions for regional clear cell RCCs and significantly lower ones for regional papillary RCCs. Additionally, the proportion of distant stage disease for clear cell RCCs was significantly lower in 2007. While, a smaller proportion of transitional cell carcinomas were diagnosed locally in 2007 compared to 2001 and a larger proportion were diagnosed regionally or distantly, the differences were not statistically significant (Figure 7).

Figure 7. Stage at Diagnosis of Kidney Cancer by Histology, Massachusetts, 2001 and 2007



Renal Cell Carcinoma Incidence: The rate for all renal cell carcinomas (RCC) increased at a statistically significant rate from 1998 to 2007 (annual percent change (APC) =24.4). Among the subtypes, clear cell RCCs (N=2394), increased at a statistically significant rate from 1/100,000 to 6/100,000 (APC=29.6), and papillary RCCs (N=740) increased significantly from nearly 0/100,000 to 2/100,000 (APC=29.6). While chromophobe RCCs (N=325) experienced a significant rate increase with an APC of 238.9, the rates only changed from almost 0/100,000 to around 0.4/100/000. Unclassified RCCs (N=4484) showed a statistically significant decrease in incidence rate, most likely due to improved classification of RCCs between 1998 and 2007 (Figure 8).

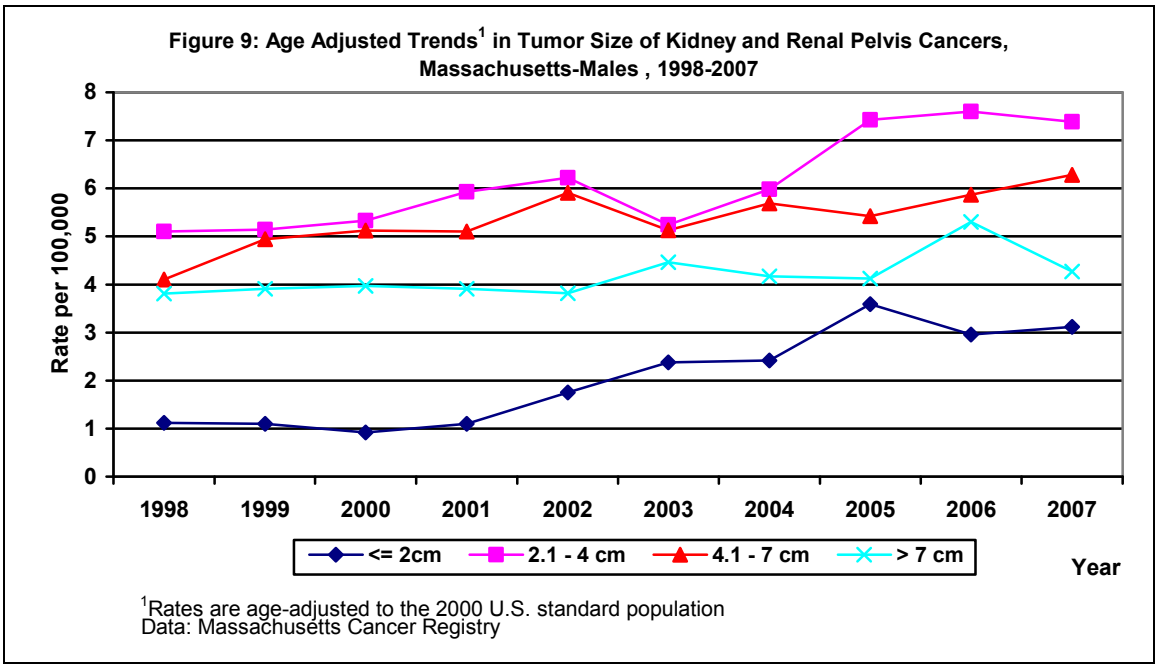
Figure 8. Age-Adjusted Incidence Rates[1] of Renal Cell Carcinoma by Histologic Subtype and Diagnosis Year, Massachusetts, 1998-2007

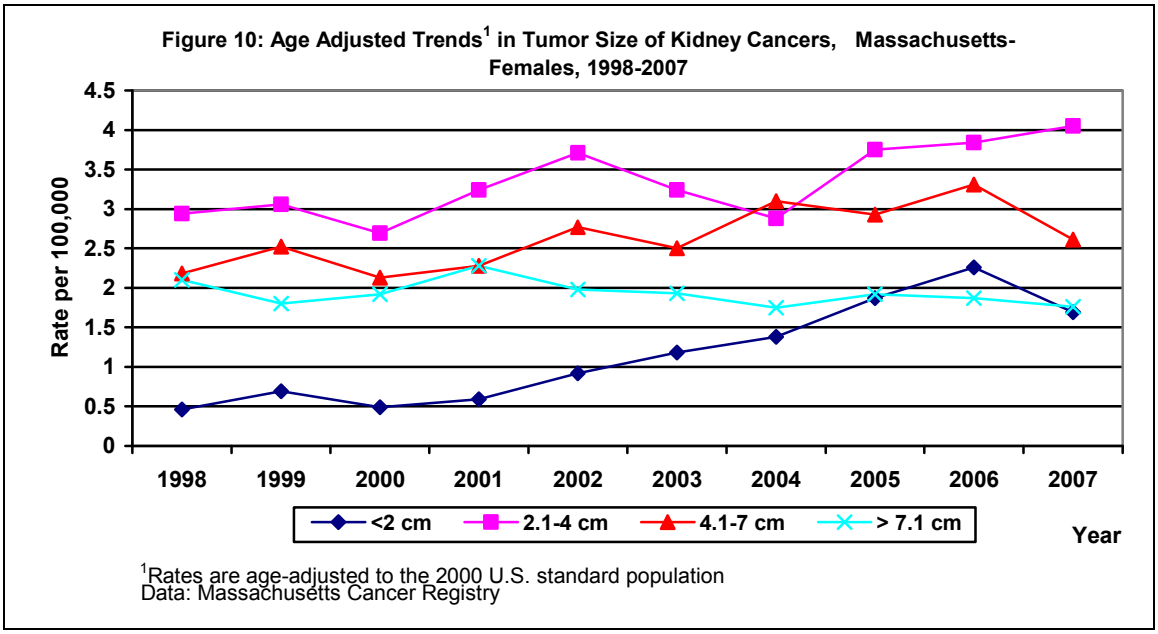


[1]Rates are age-adjusted to the 2000 U.S. population
Data Source: Massachusetts Cancer Registry

Trends in KRPC Tumor Size:

The tumor size categories (0-2.0 cm, 2.1-4 cm, 4.1-7 cm and larger than 7 cm) were based on categories defined in the *Journal of the National Cancer Institute* article on the increasing incidence of small renal masses in the United States from 1983 to 2002.[7] For the period 1998-2007, the first three tumor size categories in Massachusetts males showed statistically significant increases in incidence relative to diminishing tumor size, i.e. the incidence in the smallest size group increased at an annual percent change (APC) of 16.5%, while the next sized group had an APC of 4.7%, and the last, an APC of 3.4%. The largest size group conversely had a non-significant decrease in tumor size with an APC of -1.3% (Figure 9). Among females, the trend patterns were similar with the three smaller tumor size groups experiencing significant APC increases relative to diminishing size (19.6%, 3.5%, and 3.6%, respectively) (Figure 10). The largest size group again experienced a drop in the APC (-1.3%), although this time the decrease was statistically significant. It should be noted that during this time period data on tumor size were missing for 11% of all kidney cancer cases, with no disproportionate differences in missing data by sex and race/ethnicity.

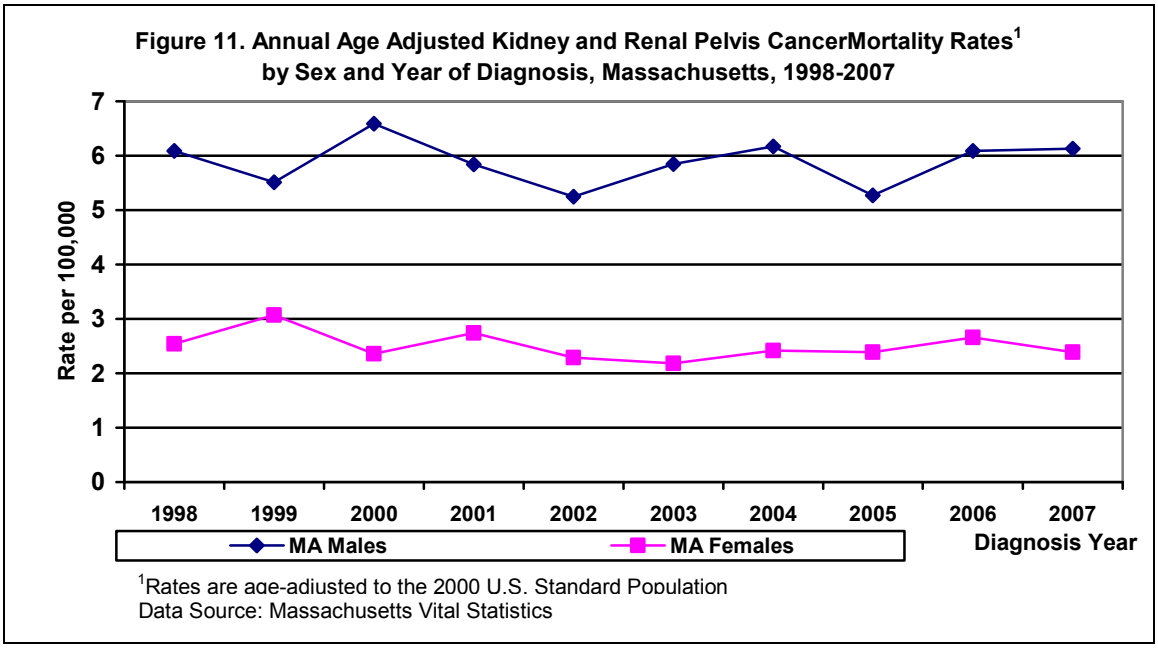




Kidney Cancer Mortality:

Mortality Rate: Among males, there were an average of 168 deaths due to cancer of the kidney and renal pelvis from 1998 to 2007. The age-adjusted mortality rates from 1998 to 2007 are presented in Figure 11. There was no significant APC from 1998 to 2007. Among females, there were an average of 103 deaths from 1998 to 2007. The age-adjusted mortality rates from 1998 to 2007 are presented in Figure 11. There was no significant APC from 1998 to 2007. In a pattern similar to the incidence rates for this cancer, mortality rates were significantly lower for females than males. The mortality rates by specific ethnicity other

than white, NH could not be accurately determined due to small numbers. National mortality rates were similar to the rates in Massachusetts.[8]



Survival: While Massachusetts does not yet have survival data on KRPC, SEER data on the relative survival for renal cell carcinoma diagnosed from 1988 to 2001 are presented in Table 1. Survival for stages 1 and 2 KRPC was longer for white males and females and black females compared to black males, although for all groups, it was at least 9 to 10 years. Survival for stage 3 KRPC was also better for whites compared to blacks, a year and a half longer than black males and three years longer than black females. There were no substantial differences for stage 4 KRPC; all groups had a median survival under 1 year.[9]

Table 1: Median Survival Time (Months) –Kidney Renal Cell Carcinoma SEER 1988-2001 Diagnoses

AJCC Stage	White Males	White Females	Black Males	Black Females
Total	86.1	105.0	66	104.7
Stage 1	>120	>120	116.4	>120
Stage 2	>120	>120	112.5	>120
Stage 3	76.6	74.9	58.7	35.9
Stage 4	8.1	7.0	5.6	5.8
Unstaged/Unknown	116.6	>120	99.7	110.1

DISCUSSION

KRPC was the seventh most common cancer diagnosed among males from 2003 to 2007 and the eleventh most common cancer among females. While the incidence of this cancer is much lower than the incidence of prostate, breast, colorectal, or lung cancer, the incidence of KRPC has been increasing at a statistically significant rate over the past ten years. Among males, the incidence of this cancer increased from 17.3/100,000 in 1998 to 22.1 to 2007, with a statistically significant annual percent change of 3.4%. While the incidence rate among females was statistically significantly lower than males, there was still a statistically significant jump from 9.5/100,000 in 1998 to 10.7 in 2007, with an annual increase of 2.4% each year. Similar increasing trends in KRPC incidence have been reported in several European countries and Ontario, Canada.[8,10,11] The significantly higher rates in males may be partly explained by more workplace chemical exposures and higher smoking rates.[1]

In Massachusetts, the incidence of three smallest tumor sizes at diagnosis increased significantly from 1998 to 2007, with the smallest size (< 2cm) experiencing the most significant increase. A study using SEER national data from 1983 to 2002 found increases in all of the tumor size groups, with the smallest (< 2cm) having the most significant increases.[6] These findings along with the increased use of CT scans and MRIs support the idea that more kidney cancers are being detected incidentally after scanning for other reasons. One study looking at 131 kidney cancer patient's chart who were diagnosed from 1989 to 1993 found that 61% were diagnosed without hematuria, flank pain or mass, or abdominal mass.[12] With the advent of the new imaging technologies, more guidance in the management of these incidental masses, the overwhelming majority of which are benign, is now being provided for physicians.[13]

While the incidence rates of kidney and renal pelvis cancer among males and females have been increasing in Massachusetts, the mortality rates have remained stable for both groups from 1998 to 2007. Using national data from 1983 to 2002, researchers noted that while increased numbers of smaller and more treatable tumors were being diagnosed, the larger more lethal ones were not decreasing in incidence, hence having no affect on mortality rates.[7] In Massachusetts, the incidence rates of the largest tumors (> 7cm) decreased from 1998 to 2007 as did the proportion of cases diagnosed at a distant stage. Given the decreases in larger tumor size and distant stage diagnoses, the mortality rates in Massachusetts may begin to show more significant declines.

It is important to note that while scanning technology is detecting more tumors, risk factors such as increased obesity rates may be contributing to more of the tumors occurring in the first place. Increased body mass index (BMI) has been found to be associated with an increased risk of clear cell renal carcinoma.[14,15] Higher BMI and elevated blood pressure were shown to independently increase the long-term risk of renal cell cancer in men. The same study showed that a reduction in blood pressure lowered the risk.[16] Parallel to the increased kidney cancer incidence in the United States from 1998 to 2006, there have also been increases in the national obesity and hypertension rates.[17] For all age groups, cigarette smoking also has been linked to an increased risk of both kidney and renal pelvis cancer,

with a two-fold risk of renal pelvis cancer among individuals who started to smoke before the age of 18.[18]

Regarding stage at diagnosis, there were no differences seen by gender, but black, NHs were significantly more likely to be diagnosed at the local stage than white, NHs. In a national review of cancers by race/ethnicity, black, NHs were more likely to be diagnosed at an advanced stage of cancer with the exception of KRPC and small intestine cancer.[19] It is possible that the disproportionately higher incidence of kidney failure and subsequent dialysis among black, NHs puts them at a higher risk of developing kidney cancer and having that cancer discovered at a local stage due to the added monitoring of kidney function from being on dialysis. Since the MCR data does not collect this data, it is not possible to test this hypothesis.

As kidney cancer has been linked to obesity, cigarette smoking and hypertension, efforts need to be made to reduce the incidence of these risk factors. Obesity (BMI >= 30) prevalence in Massachusetts has more than doubled in just seventeen years, climbing from10.1% in 1990 to 21.7% in 2007. From 2003 to 2007, the prevalence of obesity was 18.9% in white, NHs compared to 30.5% in black, NHs.[20] The Mass in Motion program was started by the Massachusetts Department of Public Health to combat the rising obesity rates to prevent obesity related diseases, KRPC being one of them. The website for this initiative is as follows: Mass in Motion

In addition to the Mass in Motion Program, the MDPH has a program to combat tobacco use and its deleterious health effects, including KRPC. The website for this program is as follows: http://www.mass.gov/dph/mtcp

TECHNICAL NOTES AND DEFINITIONS

Age-adjusted rate – a rate that takes into account the age structure of an area, allowing for the comparison of areas with different age distributions. Age-adjusted rates were calculated by weighting the age-specific rates of a given year by the age distribution of the 2000 U.S. standard population. The weighted age-specific rates were then added to produce the adjusted rate for all ages combined. Rates should only be compared if they have been adjusted to the same standard population.

Age-specific rate – a rate among people of a particular age range in a given time period. Age-specific rates were calculated by dividing the number of people in an age group who were newly diagnosed with cancer (incidence) or died of cancer (mortality) by the number of people in that same age group overall.

Histology - the study of the microscopic structures present in cells and tissues. Histology of biopsy samples is essential for cancer diagnosis, and for determining what type of cancer may be present in the tissue and cells Histology can also be used to determine how cancerous tumors might respond to chemotherapy drugs.

Incidence – the number of people who are newly diagnosed with a disease, condition, or illness during a particular time period. The incidence data presented here were coded using the third edition of the International Classification of Disease for Oncology (ICD-O-3) coding system. Kidney and renal pelvis cancer cases were defined with an ICD-O-3 code of C64.9 and C65.9, respectively; histologies 9590-9989 were excluded. All cancers were invasive. The following histologies were used to define the main types of kidney and renal pelvis cancer:

Clear Cell Renal Cell Carcinoma=8310
Papillary Renal Cell Carcinoma=8260
Chromophobe Renal Cell Carcinoma=8317
Collecting Duct Renal Cell Carcinoma=8319
Unclassified Renal Cell Carcinoma=8312
Transitional Cell Carcinoma=8120, 8122, 8130
Wilms Tumor=8960
Other/Unknown=any histology not mentioned above, except 9590-9989

Mortality – the number of people who died of a disease, condition, or illness during a particular time period. The mortality data presented here were coded using the tenth edition of the International Classification of Diseases (ICD-10). Kidney and renal pelvis cancer was defined as C64-C65 (ICD-10).

Population estimates – rates were calculated using population estimates obtained from the Massachusetts Department of Public Health (MDPH) using the Massachusetts Community Health Information Profile (MassCHIP) demographic/census files.

Race/ethnicity – The categories presented in this report are mutually exclusive. Cases are only included in one race/ethnicity category. The race/ethnicity tables include the categories white, non-Hispanic; black, non-Hispanic; Asian, non-Hispanic; and Hispanic.

Relative Survival - According to the SEER Survival Monograph, "relative survival is a *net survival* measure representing cancer survival in the absence of other causes of death. Relative survival is defined as the ratio expressed as a percent of the proportion of *observed* survivors in a cohort of cancer patients to the proportion of expected survivors. Thus, a relative survival of 100% means that a cancer patient cohort is just as likely to survive the given interval as a cohort in the general population of the same sex, age, and race. It does not mean that everyone will survive their cancer. For example, in a group of screening found cancers, many of the people seek medical care on a more routine basis than the general population and may have better non-cancer survival than the general population. In this case the expected life table is too low which makes the relative rate too high. On the other hand, lung cancer patients who smoke may be at excess risk of dying of other smoking related causes than the general population and the calculated expected rate would be too high which means that the relative survival rate may be lower than it would be if life tables based on smoking could be used.[9]

Stages of Cancer – For this report, there were three stages of cancer utilized: localized cancer which was found only in the body part (organ) where it began and has not spread; regional cancer which has spread beyond the original point of origin to the nearest surrounding parts of the body (other tissues including regional lymph nodes); and distant cancer which has spread to parts of the body far away from the original point where it began. In the section on survival where national data were used, there were four stages of kidney cancer described as follows:

Stage 1 – The tumor is within the kidney and is less than 7cm.
Stage 2 – The tumor is within the kidney, but is greater than 7cm.
Stage 3 – Cancer cells from the tumor have spread to a nearby lymph node or blood vessel or has invaded the adrenal gland or the layers of fat surrounding the kidney.
Stage 4 – The tumor has extended beyond the fibrous tissue that surrounds the kidney, cancer cells have been found in more than one nearby lymph node, or the cancer has spread to other parts of the body, such as the lungs. (NCI booklet)

Trend – Trend data were analyzed using the Joinpoint Regression Program from the National Cancer Institute. This program identifies joined line segments that are connected by points where the trend changes. An annual percent change (APC) describes the average change per year over the line segment. A positive APC corresponds to an increasing trend, and a negative APC corresponds to a decreasing trend. Joinpoint analysis determines whether or not the APC is significant.

Analyses of differences in stage were performed using χ square analysis. Significant differences between proportions in this report had p values less than 0.05.

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