A Report to the
Texas Comprehensive Cancer Control Coalition

The Cost of CANCER in Texas

The Economic Impact of Cancer:

- Direct and Indirect Costs
- Cost-Effectiveness of Cancer Prevention
- Hospital Inpatient Costs of Cancer

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COMPREHENSIVE CANCER CONTROL PROGRAM

http://www.tdh.state.tx.us/tcccp

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A Report to the
Texas Comprehensive Cancer Control Coalition
on the Economic Impact of Cancer

by
The Lyndon B. Johnson School of Public Affairs,
The University of Texas at Austin
and the
Texas Health Care Information Council

- **Executive Summary**

Philip Huang, M.D., M.P.H., *The Texas Department of Health*

- **Direct and Indirect Costs, 1998**

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- **Literature Review and Analysis on Cancer Prevention and Cost-Effectiveness**

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- **Hospital Inpatient Costs of Cancer in Texas**

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The Cost of Cancer in Texas

Executive Summary

Introduction: Cancer is the second leading cause of all deaths in Texas, so it affects almost everyone in this state. The devastation caused by this disease occurs at many levels – not only for those who are diagnosed, but loved ones, employers and others. The Texas Comprehensive Cancer Control Coalition commissioned a study to determine the financial impact of cancer to the state of Texas. The Coalition is comprised of representatives from public and private organizations that are major stakeholders related to cancer issues in this state. This group meets quarterly to advance the use of the Texas Cancer Plan – the statewide plan developed by the Texas Cancer Council for coordination of cancer control efforts in Texas. The Coalition intends this report to aid local, regional and statewide cancer control, legislative and health policy planning bodies to develop relevant programs and services that address the burden of cancer on our citizens and our economy.

In 2000, Dr. David C. Warner, of the University of Texas LBJ School of Public Affairs, led a team of researchers who, together, developed this comprehensive study of the annual costs of cancer in Texas. This summary presents highlights of their report – which is available at no cost through **http://www.tdh.state.tx.us/tcccp/costs.htm**

Background: U.S. national costs of cancer in 1993 were estimated at about $104 billion[1], and cancer is estimated to account for about 10 percent of national health expenditures[2]. Costs have been increasing, due partly to growth and aging of the population and partly to increased duration and complexity of treatment – as well as medical price inflation[3]. This report on cancer in Texas estimates direct and indirect costs in 1998, including estimates for some of the components associated with colorectal, lung, breast and prostate cancers.

Methods: The calculation of direct costs included costs of hospitalization, inpatient physician services, outpatient care and freestanding cancer treatment centers, emergency services, home health and hospice care, cancer screening, and retail pharmaceuticals; and expenditures of state agencies, non-profit groups and private foundations. Indirect costs included those associated with lost productivity due to illness and disability, as well as 'lost opportunity costs' – the value of future productivity estimated to be lost to the state, based on premature death due to cancer.

Results: Total estimated direct medical costs due to cancer in 1998 were $4.9 billion, and indirect costs from lost productivity were $9.1 billion – for a total of about $14.0 billion attributable to cancer in Texas that year. Additional breakdown of the total cost estimates by major cancer types were approximately: $1.2 billion for colorectal cancer, $2.2 billion for lung cancer, $1.2 billion for breast cancer, and $445 million for prostate cancer – as shown in the following table:

Costs of cancer in Texas, 1998 (*all figures x $1,000,000*)

Cost Component	All Cancer	Colorectal	Lung	Breast	Prostate
Hospitals	$ 1,852.6	$ 161.4	$ 228.0	$ 91.3	$ 98.2
Inpatient physicians	400.2	34.9	49.3	19.7	21.2
Emergency services	17.7	1.5	2.2	0.9	0.9
Outpatient treatment	1,427.0	---	---	---	---
Home health	237.5	---	---	---	---
Hospice care	107.9	---	33.9	6.8	5.1
Cancer screening	665.6	255.5	---	206.2	26.7
Retail pharmaceuticals	138.7	---	---	---	---
State agency budgets	14.1	---	---	---	---
Nonprofits and foundations	22.9	---	---	---	---
Direct Costs	**$4,884.1**	**$ 453.3**	**$ 313.4**	**$ 324.9**	**$ 152.1**
Disability	4.143.5	283.4	642.8	486.4	203.6
Mortality	4,974.8	460.7	1,223.1	437.7	89.8
Indirect Costs	**$ 9,118.3**	**$ 744.1**	**$ 1,865.9**	**$ 924.2**	**$ 293.3**
Total	**$ 14,002.4**	**$ 1,197.4**	**$ 2,179.3**	**$ 1,249.0**	**$ 445.4**

--- *Data not available*

Discussion: The estimated $14.0 billion cost due to cancer in Texas in 1998 represents a significant portion of health care costs to the state. Tobacco use cessation and prevention activities, appropriate cancer screening and early detection efforts, and other programs comprehensively addressing cancer prevention and control are needed to reduce the tremendous economic burden of cancer.

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For a printed copy of this report, please contact the Texas Department of Health’s Comprehensive Cancer Control Program –
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The Cost of Cancer in Texas

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Executive Summary

The standard method for conducting a cost-of-illness study involves estimating the direct costs and indirect costs incurred in a particular year that are attributable to the condition under study. In this study we estimated the economic impact of cancer in Texas for the year 1998. Our calculations resulted in estimated direct medical costs of $4.9 billion and estimated indirect costs from lost productivity of $9.1 billion, for a total of about $14.0 billion attributable to cancer in 1998. Estimates are given in this report for four specific common cancers where the data allowed (colorectal, lung, breast, and prostate), and costs are broken out by Texas Public Health Region where possible.

Introduction and Purpose

U.S. national costs of cancer in 1993 were estimated at about $104 billion,[1] and cancer is estimated to account for about 10 percent of national health expenditures.[2] Costs have been increasing, due partly to growth and aging of the population and partly to medical price inflation. Costs also reflect changing services. Technological innovation has improved survival, but has also increased costs; expansion of screening programs has increased spending in hopes of longer-term cost savings, and a shift from inpatient to ambulatory treatments has reduced direct spending.[3] As the population ages, costs in the future can be expected to increase, although the ramifications of increased incidence due to aging of the population versus increased prevalence due to improved survival are unclear.[4]

Texas, with about 7.4 percent of the national population, might be expected to experience a proportionate share of the costs of cancer. However, in 1998, Texas had about 6.3 percent of the nation's new cancer cases and 6.3 percent of the cancer deaths.[5] Texas has a unique demographic structure, younger in age and with a large Hispanic population, which differs from much of the rest of the country. The behaviors of the population differ with respect to smoking, diet, and other influences on cancer incidence. Also, the health care system is not as fully developed and not as readily accessed as in many other areas of the country. Thus, evaluation of cancer costs in Texas is best constructed on the basis of information from within the state, and not simply calculated as a proportion of national costs. This report on the cost of cancer in Texas aims to estimate the direct and indirect costs of cancer in Texas in 1998. Besides the costs of cancer as a whole, costs are also broken out by four particular types of cancer, where possible: colorectal, lung, breast, and prostate.

Background

Evaluations of the economic consequences of diseases generally employ a cost-of-illness technique. The method includes estimates of direct and indirect costs of illness.[6] *Direct medical costs* reflect resources consumed by the health care system. Such costs may include hospital inpatient and outpatient services, ambulatory surgery, care by physicians and other practitioners, nursing home and home health services, drugs, rehabilitation services, and a variety of items such as prostheses, appliances, wigs, hearing aids, and speech devices.[7] National studies suggest that direct medical costs account for about 24-35 percent of the costs of cancer.[8]

Indirect costs reflect lost productivity due to morbidity and mortality including work in and outside the home and time spent care-giving by family members and friends.[9] National studies suggest that about 65-76 percent of the costs of cancer are due to lost productivity, mainly from the loss of lifetime earnings due to premature mortality.[10] Estimates of future earnings lost to premature mortality are discounted to present value to reflect the time value of money and so the costs will be comparable to the direct costs.

The term "cost" refers to the economic value of all resources consumed or not produced as a consequence of an illness. Economists measure such resources in terms of "opportunity costs"—the value those resources would have generated in their next best alternative use.[11] While charge data have sometimes been employed for costing health care services, researchers agree that, in the absence of information on costs of production, actual payments better reflect the social opportunity costs of illness.[12]

Most cost-of-illness studies are prevalence-based, that is, they consider current costs of prevalent cases (usually within a certain year), rather than future costs of incident cases. For example, in a study that relied mainly on national data, Williams and Begley estimated Texas cancer costs in 1988 at $4.4 billion, compared to $2.4 billion in 1980.[13] The incidence-based approach, on the other hand, would consider new cases of illness and estimate the costs of the illness over patients' lifetimes.

Cost-of-illness studies convey the aggregate burden of illness on society, contribute to the setting of priorities for public investments,[14] and can serve to monitor trends. However, one should recognize that estimating costs of a disease is only a first step toward economic evaluation of a disease. While a cost-of-illness study can provide a picture of the overall dimension of a health problem and can serve to educate and to indirectly inform public policy, it does not provide information about potential effectiveness or benefits of interventions, information needed for rational allocation of resources.[15] While the cost of disease is important information, one must also know what can be done about it and the amount of resources required.[16] A beginning step toward more substantial economic evaluation of a disease is the incidence-based approach, which looks at the lifetime cost of a new case of the disease and provides base information that can be used in cost-effectiveness studies and in evaluating the potential for savings from prevention of cases.

While there is general agreement in the broad theoretical approaches to cost-of-illness studies, in practice, methodological details vary widely. For example, methods employed in studies of U.S. national diabetes costs have varied so extensively that reviewers have had great difficulty in comparing the respective findings.[17] Among the variations in methods for estimating the direct costs of a disease is the distinction between "top-down" and "bottom-up" approaches. In the former type of study, the researcher begins with global costs of all disease and tries to allocate costs between or among the respective diseases. In the latter type of study, the researcher is not concerned with global costs, and focuses instead on building a cost estimate for the disease of interest from information on expenditures or economic inputs.[18]

The methods for estimating indirect costs are described in the literature as using a "human capital approach." The approach values people in terms of their productive capacity. Obviously, that is only one limited perspective on the value of human life. An alternative approach called "willingness-to-pay" considers the amount which people might be willing to pay to reduce or avoid probability of illness or death from a disease. While attractive from a theoretical perspective, the method is rarely employed because of the practical limitations of generating appropriate data.[19]

We should note that, in addition to direct and indirect costs of disease, there also are psychosocial costs such as pain, suffering, loss of self-esteem, and emotional issues for those afflicted and their loved ones associated with disease. Such costs are generally acknowledged, but rarely measured. Also, in Appendices A and B, we provide information on two alternative approaches to measuring some of the costs of cancer. The first of these (Appendix A) is based on the U.S. Medical Expenditure Panel Survey, or MEPS. The second (Appendix B) is based on the Smoking-Attributable Mortality, Morbidity, and Economic Costs, or SAMMEC, software program developed by the Centers for Disease Control and Prevention.

Methods

We employed a "bottom-up" approach to measuring the costs of cancer in Texas in 1998 by estimated the costs for various components. For direct costs, we estimated costs of hospitalization, inpatient physician services, outpatient care and freestanding cancer treatment centers, emergency services, home health and hospice care, cancer screening, retail pharmaceuticals, and expenditures of state agencies, non-profit groups, and private foundations. For indirect costs, we estimated current year costs of lost productivity due to illness and disability, and the present value of lost future productivity due to current year mortality.

Direct Costs

Due to the unavailability of some data and lack of consistency in others, we had to employ a variety of different methods in calculating the various facets of direct costs. The methods used are broken out below by specific component, as different data sources and methodologies were used for each one.

Hospitalization: Information on hospital utilization by cancer patients came from a database compiled by the Texas Health Care Information Council (THCIC), and from supplemental data supplied by the Texas Medicaid program. The THCIC hospital database contained records for each hospital stay at most Texas hospitals, including rehabilitation hospitals, during the period from January through March, 1999. Hospital stays with a principal diagnosis of cancer (ICDs 140-239) were viewed as *directly attributable* to cancer. Stays with another principal diagnosis, but having cancer among any of eight secondary diagnoses, were viewed as *indirectly attributable* to cancer. The two types of stays combined were viewed as *total stays attributable* to cancer.

All hospital stays which were attributed to cancer were further examined to determine whether any of four specific types of cancer were present among the diagnostic codes: colorectal (ICD 153-154), lung (162), breast (174), and prostate (185). To avoid double-counting, when records contained diagnostic codes for more than one kind of cancer, including types of cancer other than the four types of interest, priority was given to the type of cancer listed earliest among the nine possible diagnostic codes.

For cancer stays at seven children's hospitals, charge information was adjusted by Medicaid cost-to-charge ratios for 1998, including discount factors, to obtain an estimate of cancer costs. For all other hospitals, costs were estimated by multiplying the Medicaid Adjusted Standard Dollar Amounts (ASDA) and the Medicaid DRG Weights. The Medicaid ASDAs are based on hospital-specific analyses of average patient costs. The DRG weights adjust for differences between types of patients. A handful of hospitals were not Medicaid contractors and, for these, the Standard Dollar Amounts (SDA), unadjusted for Medicaid contractual discounts, were applied to the Medicaid DRG weights. Fifty-four cancer-related stays in the database had DRGs with a weight of zero and, for those stays, costs were estimated on the basis of the average cost among stays for persons having the same type of cancer (colorectal, lung, breast, prostate, other).

Because information was available for only one calendar quarter, the number of hospital stays and the associated cost estimates were annualized by multiplying by a factor of four (thus assuming that the quarters were equal, since cancer incidence is not very seasonal). Attention was given to place of residence of the respective patients in order to distinguish between hospitalizations of Texas residents and non-residents. Also, the THCIC database did not include information for about 6 percent of the non-federal hospital beds in Texas. No adjustment was made for the missing data because such beds were in small community hospitals which were unlikely to have large numbers of cancer patients.

Based on the one calendar quarter of information from the THCIC database, we also calculated the annualized distribution of hospital stays and inpatient facility costs for cancer by Texas public health region. Costs were assigned to the various regions based on the residential zip codes of the patients in the database. Cancer cases were included in the table whether listed as principal or among secondary diagnoses, and care was taken to count only the first-listed cancer in situations where multiple cancers were present.

Inpatient Physicians: There were no direct measures available for the cost of physician services to treat persons hospitalized with cancer. Thus, alternative sources of indirect information were considered. Data from the 1996 U.S. Medical Expenditure Panel Survey (MEPS) suggest that inpatient physician costs for cancer patients were about 11 to 12 percent of inpatient facility costs. However, these data have limitations in their application to Texas (see Appendix A for details). Researchers in California report that the figure is about 15 percent using data from the U.S. National Medical Care and Expenditure Survey (NMCES).[20] In an earlier study of the Medicare program with matched records for inpatient facility and physician services, researchers reported that costs of inpatient physician services amounted to about 16 percent of hospital costs.[21] These two studies examined costs among all patients and did not focus on cancer patients.

Currently underway is a national analysis of Medicare patients using matched billing records for inpatient facility and inpatient provider costs. This analysis examines provider/facility reimbursement ratios for each of the various DRGs.[22] The 25 most common DRGs among cancer patients within the THCIC inpatient database accounted for about half of the hospital stays among cancer patients, and the provider/facility cost ratios for those DRGs, taken from the national Medicare analysis, ranged from 5.2 to 36.9 percent (see Appendix D for details). We averaged the various ratios while weighting the data for the number of inpatient stays among cancer patients under each DRG within the THCIC database and also weighting for the Medicaid Adjusted Standard Dollar Amounts. This procedure yielded a weighted average ratio of 21.6 percent, and this figure was applied to the Texas estimate for inpatient facility costs among cancer patients.

Outpatient Treatment and Freestanding Cancer Centers: Calculating the cost of the considerable amount of outpatient treatment that occurs in the state is very difficult, as this occurs in a variety of settings—hospitals, doctors' offices, and freestanding cancer centers—and there is not a centralized source for data. We use several indirect and partial measures to estimate the costs of outpatient treatment. These include the Medical Expenditure Panel Survey (MEPS) data presented in Appendix A, estimates based on data provided in the 10-K of U.S. Oncology regarding 1998 revenue of Texas Oncology, P.A., and M.D. Anderson data that we adjusted to estimate net outpatient treatment expenses. The MEPS data is based on adjusting a national sample and it measures attributable costs of cancer in Texas, which means the additional costs that persons with cancer incur relative to the general population. For the purpose of measuring outpatient costs we added together the total costs of the following categories: hospital outpatient facility, hospital outpatient provider, and office-based physician and non-physician.

The one data source that we had available that covered non-inpatient hospital care across the state was provided by the S.E.C. Form 10-K for 1999 for U.S. Oncology, who owns a number of freestanding cancer centers in Texas and in other states. According to this report one physician group, Texas Oncology, P.A., contributed 32 percent (equaling $237.7 million) of U.S. Oncology's total revenue in 1998, which was $836.6 million. This figure includes "pharmaceuticals and supplies used by affiliated physician's groups, salaries, wages and benefits of the affiliated physician's groups employees (excluding affiliated physicians) and the company's employees located at affiliated practice sites and business offices and other practice costs," as well as corporate profits.[23] It does not include physician compensation and benefits or, in 1998, professional liability costs. After review of the data and speaking with several oncologists and others, we determined that physician compensation and benefits including professional liability coverage was probably about 25 percent of the total, or one-third of the other costs. This generated total costs for Texas Oncology for 1998. Of the 30 freestanding cancer centers in Texas in 1998, the companies that merged to form U.S. Oncology (in 1999) owned 13 of these in 1998. Ten centers were owned by Physician Reliance Network (PRN) and Texas Oncology, P.A., and three centers were owned by American Oncology Resources (AOR).[24]

Assuming Texas Oncology, P.A., represents 25 percent of the revenue of all outpatient cancer treatment in the state, we multiplied our 1998 estimate for Texas Oncology by four to generate an estimate of the total outpatient costs in Texas. This may include some inpatient billings for procedures such as bone marrow treatments, chemotherapy, or radiation treatments, but it probably excludes radiation treatment by physicians not part of oncology practices, and care by urologists, OB-GYNs and other practitioners involved in outpatient cancer care.

As a third measure to see if our estimates were in the "ballpark" we disaggregated data on M.D. Anderson Cancer Center. In 1998, M.D. Anderson in Houston admitted 15,920 patients and had 368,605 clinic visits. In order to estimate outpatient clinical expenses we took the 1998 total M.D. Anderson expenditures ($779,006,782[25]), subtracted the inpatient hospital estimate from the THCIC data ($248,115,000[26]), subtracted total research costs ($115,225,532[27]), and added in 60 percent of the M.D. Anderson practice plan expenditures ($65,069,084[28]). The M.D. Anderson numbers may be somewhat inflated by non-Texans, but those from outside of Texas are certainly a lower percentage than they are of inpatients. On the other hand, some of the research expenditures are for clinical trials and clinical treatments, which probably should be included.

Emergency Services: We were unable to locate a Texas-based source of information on the cost of emergency services. Our estimate, therefore, was based on the ratio of emergency room facility and physician costs to inpatient facility costs as calculated from the U.S. Medical Expenditure Panel Survey. Costs of emergency services were small—less than 1 percent of inpatient facility costs (see Appendix A for details on MEPS).

Home Health Care: To calculate this cost we obtained an estimate from the Health Care Financing Administration (HCFA) on the amount spent by all payers in Texas in 1998 for home health care ($2,862,000,000).[29] In the absence of Texas-specific data on home care costs and use by cancer patients, we obtained national data from the National Association for Home Care (NAHC) that showed that 8.3 percent of people discharged from home health care had malignant neoplasms (ICD-9-CM codes 140-208, 230-234) listed as their primary diagnosis in 1995-1996 (we could not obtain later data but it is reasonable to assume the diagnoses would not change much within two years). In absence of specific data breaking out costs of home care by different diseases, we had to assume that people using home health due to cancer incur average costs that are similar to those due to other diseases, so we applied the 8.3 percent figure to the total amount spent on home health care in 1998 to get an estimate of the cost of home health care due to cancer. According to the NAHC, breaking this percentage down further by types of cancer produced numbers too small to be reliable (cancer is not in the top ten diagnoses of Medicare recipients using home health care after hospitalization).[30]

There is a chance that part of the home health care cost estimate overlaps with the hospice care estimate described in the next section (it would be the part pertaining to costs of hospice care administered by a home care organization). HCFA pays for home health as a separate benefit from hospice, but many home health care agencies could offer both of these services and could bill for both, and the cost data available on "home health" does not allow us to determine exactly what costs are used to comprise this.

Hospice Care: We obtained data from the NAHC that showed that for all hospices in Texas, total charges in 1997 were $156,605,000 and total reimbursements were $154,796,000 (from Medicare, Medicaid, or private insurance).[31] This data also showed that malignant neoplasms (ICD-8-CM codes 140-208, 230-234) were the primary admission diagnosis of 69.7 percent of hospice patients nationwide in fiscal year 1996. Colorectal cancer (codes 153-154) was not broken out of this percentage, but three other cancers were: malignant neoplasms of the trachea, bronchus, and lung (codes 162, 197.0, 197.3) accounted for 21.9 percent of primary diagnoses; breast cancer (codes 174-175, 198.81) was 4.4 percent, and prostate cancer (code 185) was 3.3 percent.[32] The diagnosis data are from one year earlier than the patient and financial data (which is one year earlier than our target year of 1998), but we would not expect much change in these figures in this short time frame. The diagnosis percentages are on a national level, but lacking state-level data, we assumed that hospices in Texas had similar admission diagnoses in 1998 and that these patients had costs similar to those receiving hospice for other conditions. We therefore applied the percentages of cancer admissions to the total reimbursements for an overall estimate of the cost of hospice care due to cancer, then applied the percentages due to lung, breast, and prostate cancers to arrive at an estimate of costs due to those specific cancers.

Cancer Screening: It is difficult to obtain accurate figures for routine screening tests since they are usually done along with a regular physical examination and are not reported anywhere as they occur. Therefore, statistics on these tests are usually obtained from periodic surveys of people's health-related behaviors, and thus depend on the accuracy of their recall of past events. To obtain estimates of the costs of common cancer-screening procedures performed in 1998, we multiplied an estimate of the number of people who received each screening test by the estimated cost of each procedure to get a total for each procedure, then added these together to get the overall cost of screening. Due to unavailability of data, these screening costs do not include costs of follow-up testing and procedures (such as biopsies) that may be indicated by true or false positives, nor costs of any complications arising from screening or follow-up tests. Although lung cancer is very prevalent and often fatal, there are no widely accepted screening tests for lung cancer and screening is not routinely done, so costs are not included in this section. Note that there was no way to distinguish between instances in which these tests were given for screening purposes (in asymptomatic people) and those that were given for diagnostic purposes (when cancer is suspected). Since the purpose of all of these tests is early detection, we referred to them all as "screening," though some may have been considered "diagnostic" when administered.

The screening costs analyzed are mammograms for breast cancer detection; Pap smears for cervical cancer; prostate-specific antigen (PSA test) for prostate cancer; and fecal occult blood test (FOBT), sigmoidoscopies, and colonoscopies for colorectal cancer. The average costs for each were obtained from various sources as noted in the findings section. The numbers of people screened were based upon random-sample surveys of people in Texas saying that they had the procedure in question within the past year (except for colonoscopies), and were obtained from the American Cancer Society (except the PSA numbers), who calculated them from state and national sources.[33]

The data from the American Cancer Society were given in percentages only, so we multiplied these by the appropriate subgroups of the Texas population in 1998 (the question on Pap smears was asked to women aged 18 and over, mammograms and clinical breast exams to women 40 and over, and the colorectal screening questions to both men and women 40 and over).[34] The PSA screening numbers (percentage and estimated number of men screened in Texas) were obtained from unpublished results from the Texas Department of Health's 1999 Texas Behavioral Risk Factor Surveillance System survey (BRFSS). The percentages of people screened using mammograms, clinical breast exams (we reported this number but could not obtain cost estimates), and Pap smears were for 1998, while the percentages screened using FOBT and sigmoidoscopies are for 1997 (though they were applied to the 1998 population). The numbers receiving colonoscopies are estimated based on numbers from 1996, and the PSA screening numbers are from 1999, as the survey question was not asked in 1998.

We could not locate Texas-specific statistics on the annual number of colonoscopies but wanted to include this as the costs can be significant, so we estimated costs for this procedure as follows. There were about 1,395,000 colonoscopies in the U.S. in 1996 (1998 data was not available).[35] Texas had about 7.2 percent of the U.S. population in 1996,[36] so we assumed that Texas had 7.2 percent of the colonoscopies, or 100,440. Since Texas has a younger average population than some states and colonoscopy is recommended after age 50, this number may be too high, but since the number surely increased in 1998 as Medicare began covering screening colonoscopies that year (diagnostic and surveillance colonoscopies were already covered), this should balance out and provide a reasonable estimate for 1998. Cost estimates can vary greatly, so we picked an average cost and multiplied this by the estimated number in Texas to obtain estimated colonoscopy costs for 1998. Since the survey question on the BRFSS regarding sigmoidoscopies actually asked if the person had had a "sigmoidoscopy or proctoscopic exam" within the last year, we calculated the estimated number of people who had these from the percentages and then subtracted the estimated number who received colonoscopies (calculated above) to arrive at the number for sigmoidoscopies, so those who received colonoscopies instead of sigmoidoscopies were not double-counted because of the wording of this question.

Retail Pharmaceuticals: To help estimate the cost of retail pharmaceuticals in Texas used to treat cancer and related side effects, we contracted with the Center for Pharmacoeconomic Studies within the College of Pharmacy at the University of Texas at Austin to analyze data from the Texas Medicaid Vendor Drug Program (the Center has data use agreements with the Vendor Drug Program to conduct routine reporting and analytical services on Texas Medicaid pharmacy claims data). The Center for Pharmacoeconomic Studies provided data regarding payments for retail pharmaceuticals obtained by cancer patients with Medicaid drug benefits in 1998, both for oncology drugs used to treat cancer and for drugs commonly used to treat related side effects such as nausea (we determined that it was not relevant to include the costs of additional drugs used by these patients that were prescribed for conditions not related to cancer or treatment side effects, as these probably would have been used by these patients even in the absence of cancer).

The specific groups of costs that make up the estimate of all relevant retail pharmaceuticals used by cancer patients on Medicaid in 1998 are the following: [1] the cost of all oncology drugs paid for by the Vendor Drug Program; [2] the costs of all drugs used to treat side effects that were obtained by anyone who also obtained an oncology drug under this program (i.e., the population in group 1); and [3] the cost of all drugs to treat side effects obtained by people who did not obtain their oncology treatment drugs through the Vendor Drug Program (i.e., they obtained their cancer drugs directly from a doctor's office or hospital, so they were not included in group 1). This third group was identified by extracting medical claims from the Medicaid medical service utilization database based on relevant ICD-9 codes of any cancer and subtracting group 1 to get those who had cancer but who did not obtain oncology drugs (only obtained related drugs) through the Vendor Drug Program.

Once we had the costs for retail cancer and related pharmaceuticals for the population eligible for Medicaid pharmaceuticals and the total number of cancer patients that had obtained these drugs on a retail basis, we divided the costs by the population to get a per capita estimate of how much an average cancer patient and/or his or her insurance company might pay for retail pharmaceuticals, in addition to the medications obtained in other settings. We then multiplied this average cost by the total population in Texas that was undergoing cancer treatments in 1998, for which we used 200,000 as a proxy (calculated by using the number of people hospitalized with any cancer diagnosis in the first quarter of 1999—50,349 patients, according to THCIC hospital data—and rounding off and multiplying by four to equal one year, assuming that almost all of these people would need additional cancer treatment before or after hospitalization). This number could be considered too low, as it does not reflect people hospitalized previously or not hospitalized at all who were receiving treatment, and because our calculations in the indirect costs section estimate that 247,000 people were considered disabled due to cancer in Texas in 1998 (see Table 3), but it could also be inflated in that it could contain multiple hospital admissions by the same person in one year, so these factors probably balance out and make this a reasonable proxy. Multiplying this proxy by the average per capita cost of relevant pharmaceuticals under Medicaid gave us an estimate of the total cost of retail cancer-related pharmaceuticals in Texas in 1998 for all cancer patients. This is not intended to be an estimate for *all* pharmaceutical products used by cancer patients in Texas; cancer drugs provided in inpatient and outpatient settings are billed by those facilities outside of the Vendor Drug Program and are already captured in other sections of this report.

State Agency Budgets: To calculate the portion of state agency budgets that is cancer-related, we first went to the online reference guide on the Texas Health and Human Services Commission's webpage and searched by the keyword "cancer."[37] The results of this search were seven programs, all within the Texas Department of Health (TDH). We contacted the TDH Budget Department to obtain the 1998 budgets for these cancer-related programs, which were the Cancer Registry Division (in the Bureau of Epidemiology), the Breast and Cervical Cancer Control Program, the cancer prevention component of the Chronic Diseases Community and Worksite Wellness Division, the cervical cancer component of the Maternal Health Program, the Medical Transportation Program (has cancer transportation programs in seven Texas counties), the Prostate Cancer Education Program, and the tobacco portion of the Bureau of Disease, Injury, and Tobacco Prevention. The Texas Cancer Council is not under the Health and Human Services Commission's umbrella, so we contacted them separately to obtain their budget for fiscal year 1998. We then added all of these budgets to obtain a total for fiscal year 1998.

This total is a conservative estimate for state agencies as there are probably other programs that deal with aspects of cancer control and prevention, such as nutrition, health education, asbestos control, and other environmental factors. To the extent that some of the programs included in this section provide screening procedures directly, there could be some double-counting between these and the costs calculated in the screening section of this report, but we cannot break these out with the current data and any cost overlaps should be small relative to the overall cost estimates.

Nonprofits and Foundations: Non-profit organizations and foundations play a large role in funding research and in cancer treatment and management for some individuals; however, it is extremely difficult to calculate the overall financial contribution of these entities. We did research at the Regional

Foundation Collection at the library of the Hogg Foundation for Mental Health, and found that there are 124 foundations in the state of Texas that fund cancer research and/or treatment in some capacity. It is difficult to calculate the financial impact of these organizations in a single year due to various reasons, one of which is that grant-making foundations usually do not focus on only one cause. Secondly, grants are often given to hospitals or large organizations whose budgets are already included elsewhere in this study, e.g., M. D. Anderson Cancer Center received over $45 million in cash gifts, pledge gifts, and in-kind gifts for their 1997-98 fiscal year.[38] To include this amount in total direct costs of cancer would be double-counting the dollars already included for the M. D. Anderson expenditures and practice plan. Finally, many grant-giving organizations have yet to compile and release lists of 1998 grants and budgets.

In light of these issues and after reviewing the large list of Texas foundations, we decided it was best for this study to include only a few of the non-profits and foundations with a large presence in Texas whose sole purpose is to serve cancer patients and survivors. These include the Lance Armstrong Foundation, the Susan G. Komen Foundation, and the Texas Division of the American Cancer Society. To obtain their financial information we contacted each of these organizations separately and asked for their fiscal year or calendar year 1998 budgets.

Indirect Costs

Indirect costs reflect lost productivity due to morbidity and mortality including work in and outside the home and care-giving by family members and friends.[39] While mortality cost estimates are based on how many people died in the year being studied, morbidity costs are based on how many people were sick during that year.

Morbidity: We estimated the number of people in 1998 with a history of cancer diagnosis and, among those, the number with employment or housekeeping disability where cancer was the main cause. Figures were developed by aggregation of records from the National Health Interview Surveys for years 1987-1996. Counted among the disabled were three groups of individuals: (1) People ages 18-69 who were unable to work were valued according to national earnings estimates for 1997 by gender and age plus an adjustment of 18 percent for fringe benefits, with further adjustment for labor force participation rates. (2) People ages 18-69 who were employed, but with work loss days in the past two weeks due to cancer, were similarly valued, except no adjustment was made for labor force participation. (3) Other people ages 18-69 were evaluated according to imputed values for housekeeping services with adjustment for the proportion of the population which engaged in housekeeping and were not otherwise in the labor force.[40]

All calculations were specific to age and gender groups. Findings from the stratified (age, gender, and ethnicity) national sample were applied to the Texas demographic structure for 1998. The ethnic groups in the national sample were constructed as follows: Hispanic (excluding Cuban and Puerto Rican origin), Black, and White/Other. National cost values for 1997 were inflated to 1998 on the basis of the nominal increase in average weekly wage for the U.S., and then adjusted downward to Texas on the basis of median household income.

Mortality: Counts of deaths due to cancer in 1998 were obtained from the Texas Cancer Data Center, and estimates of years of life lost were based on life tables for Texas.[41] Each cancer death was assumed to incur lost wages, fringe benefits, and value of housekeeping services from year of death up to average life expectancy in Texas. Figures were calculated for 5-year age groups and by gender, and were adjusted by labor force and housekeeping participation rates. Calculation of present values employed a 3 percent discount rate and an adjustment for annual productivity increases of 1 percent.[42] As was done for estimates of disability costs, adjustments were made to apply national cost figures for 1997 to Texas in 1998. Detailed findings are provided for each of the Texas public health regions.

Items Not Included

Many of the direct and indirect costs of cancer are difficult or impossible to locate or to put into monetary terms and thus are not tabulated in this report. No costs are included in this study for removal of small non-melanoma skin cancers in doctors' offices because this is not tracked by the Texas Cancer Registry or anyone else (only melanoma is required to be reported). This is a very common procedure though probably not a significant cost issue. Costs for rehabilitation are included in the inpatient and outpatient sections if services took place in those settings, but there are probably other rehabilitation costs that we were unable to obtain. Nursing home costs are not included because we cannot obtain accurate data on diagnoses or costs of nursing home patients due to cancer. The THCIC hospital database contains data on how many people were discharged to skilled nursing facilities from hospitals, but we do not know how long they remained in nursing homes, and this does not capture people who entered in previous years or who were not first hospitalized. Also, our analysis does not include incidental costs of prostheses, appliances, special diets, clothing, or wigs unless those items were bundled into the direct costs of health care.

Local agency budgets for cancer-related activities are not included because there are thousands of municipalities in Texas and hundreds of counties, and activities funded by state agencies and some foundations and non-profits would be picked up in other sections of this report as well as total screenings (so this omission could offset any double-counting between screenings and the state agency budgets). Also, this report does not include information on military or veterans' hospitals. Other costs not included are costs of lost work by family members and friends who must care for those with cancer and home modifications to accommodate disability. Psychosocial costs among patients and their families, e.g., pain and suffering and impaired relationships, are also not included. All of these are valid costs but are virtually impossible to measure, especially on an aggregate level.

Findings: Direct Costs

Hospitalization

Of approximately 2.44 million hospital stays in Texas in 1998, about 214,000 (8.8 percent) had cancer listed among the discharge diagnoses. Among the stays associated with cancer, about 201,000 (94 percent) were hospitalizations of Texas residents. The estimated cost of treating patients with cancer exceeded $2.0 billion, of which $1.85 billion was for Texas residents. The estimated cost of treating Texas residents was similar to an estimate constructed from the national Medical Expenditure Panel Survey (MEPS)—see Appendix A for details.

Among the Texas hospitals, M.D. Anderson Cancer Center had the most discharges of Texas residents with cancer—8,612 with an estimated cost of $142 million. The next three hospitals with the most resident cancer patients were in Dallas (Baylor), Houston (Methodist), and San Antonio (Southwest Texas), which together had about 14,700 discharges of Texas residents with cancer with a total cost of $176 million. Of the 383 facilities in the Texas Health Care Information Council's database, half of the resident cancer-related discharges were from the 41 facilities serving the most cancer patients, and these accounted for 55 percent of the total cost. Using the same methods, the estimated hospitalization costs for specific cancers were $161.4 million for persons with colorectal cancer, $228.0 million for lung cancer, $91.3 million for breast cancer, and $98.2 million for prostate cancer. Table 1 breaks down these costs by public health region (see Appendix C for regional map), and more detailed information, including breakdowns by age and ethnicity, is available in the supplementary report on inpatient cancer costs in Texas.

Table 1. Estimated Cancer Hospitalizations and Facility Costs by Public Health Region of Residence, Texas, 1998

Region		All Cancers	Colorectal	Lung	Breast	Prostate	Other
1	Hospital Stays	7,180	404	640	384	424	5,328
	Cost (x $1,000)	$58,488	$4,686	$5,866	$2,692	$3,146	$42,098
	% of Total Cost	3.2%	2.9%	2.6%	3.2%	3.2%	3.3%
2	Hospital Stays	6,384	432	872	240	396	4,444
	Cost (x $1,000)	$60,589	$5,658	$8,383	$2,059	$2,774	$41,715
	% of Total Cost	3.3%	3.5%	3.7%	2.4%	2.8%	3.3%
3	Hospital Stays	50,700	3,320	5,508	2,728	3,012	36,132
	Cost (x $1,000)	$488,346	$43,412	$63,018	$23,030	$24,735	$334,151
	% of Total Cost	26.6%	26.9%	27.7%	27.2%	25.3%	26.4%
4	Hospital Stays	11,632	1,016	1,584	600	876	7,556
	Cost (x $1,000)	$105,550	$12,336	$16,583	$3,909	$6,216	$66,506
	% of Total Cost	5.7%	7.6%	7.3%	4.6%	6.3%	5.3%
5	Hospital Stays	10,852	848	1,564	600	1,072	6,768
	Cost (x $1,000)	$92,888	$9,481	$14,845	$3,697	$7,355	$57,509
	% of Total Cost	5.1%	5.9%	6.5%	4.4%	7.5%	4.5%
6	Hospital Stays	47,808	3,128	5,124	2,580	2,800	34,176
	Cost (x $1,000)	$474,219	$38,979	$55,966	$22,536	$21,835	$334,902
	% of Total Cost	25.8%	24.1%	24.6%	26.6%	22.3%	26.5%
7	Hospital Stays	18,936	1,260	2,072	1,104	1,244	13,256
	Cost (x $1,000)	$163,322	$15,424	$20,167	$7,881	$8,937	$110,914
	% of Total Cost	8.9%	9.5%	8.9%	9.3%	9.1%	8.8%
8	Hospital Stays	18,460	1,080	1,816	1,160	1,284	13,120
	Cost (x $1,000)	$160,769	$12,544	$17,983	$8,464	$8,392	$113,385
	% of Total Cost	8.8%	7.8%	7.9%	10.0%	8.6%	9.0%
9	Hospital Stays	5,500	280	588	228	392	4,012
	Cost (x $1,000)	$49,367	$3,500	$5,983	$1,766	$3,006	$35,111
	% of Total Cost	2.7%	2.2%	2.6%	2.1%	3.1%	2.8%
10	Hospital Stays	7,052	388	588	384	500	5,192
	Cost (x $1,000)	$60,740	$4,808	$5,531	$2,578	$4,221	$43,601
	% of Total Cost	3.3%	3.0%	2.4%	3.0%	4.3%	3.4%
11	Hospital Stays	16,284	1,120	1,588	988	1,164	11,424
	Cost (x $1,000)	$122,558	$10,840	$13,390	$6,013	$7,313	$85,002
	% of Total Cost	6.7%	6.7%	5.9%	7.1%	7.5%	6.7%
Total	Hospital Stays	200,788	13,276	21,944	10,996	13,164	141,408
	Cost (x $1,000)	$1,836,836	$161,668	$227,715	$84,625	$97,930	$1,264,894
	% of Total Cost	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: McCandless, Li, and Warner, "Hospital Inpatient Costs of Cancer in Texas."
Note: Totals exclude hospitalizations with place of Texas residence unknown.

Inpatient Physicians

The costs for surgeons and other inpatient physicians are billed separately from other services received while a cancer patient is hospitalized. Using the benchmark that the cost of inpatient physician services was about 21.6 percent of the cost of inpatient facility care, we estimated that the cost of inpatient physician services was about $400.2 million for Texas residents hospitalized with cancer in 1998. (For comparison, the estimate from MEPS was about $217.0 million—see Appendix A.) Using the same ratio, estimated costs of inpatient physician services were $34.9 million for persons with colorectal cancer, $49.3 million for lung cancer, $19.7 million for breast cancer, and $21.2 million for prostate cancer.

Outpatient Treatment and Freestanding Cancer Centers

Outpatient cancer treatment can take place in hospitals, doctors offices, and freestanding cancer centers that only do outpatient cancer treatment. There were 30 freestanding cancer centers in Texas in March of 1998 (see Appendix E).[43] These cancer centers include both non-profits and proprietary companies and provide chemotherapy, radiation treatment, and other cancer-related services. We obtained the number of patients served by 18 of the centers in 1998 from the Texas Cancer Registry and five more directly, for a total estimate of 21,258 patients seen in 23 out of the 30 centers in 1998 (though some of these are duplicated).

The Medical Expenditure Panel Survey data yielded estimates of attributable costs for outpatient treatment of cancer for both persons who had any cancer history and for those with any non-benign cancer history. The table below summarizes these estimates. Adding the totals for hospital outpatient facility, hospital outpatient providers, and office-based physicians and non-physicians gave a total of $1.228 billion for persons with any cancer history and $1.037 billion for persons with any non-benign cancer history (see Appendix A for details). These estimates, as discussed in Appendix A, are an attempt to adjust a national sample to Texas and are not grounded in Texas data. This shows “attributable costs,” which are different than the “actual cost” approach that we are taking.

One approach to generating a Texas estimate is to project the 1998 data from U.S. Oncology regarding Texas Oncology, P.A., to account for the whole state. The Texas Oncology, P.A., revenues for 1998 were $267.7 million. Assuming that physician’s compensation and benefits and professional liability costs were 25 percent of the total (or 33 percent of the other revenue), then the total Texas Oncology revenue in 1998 equaled about $356.9 million. If we assume that Texas Oncology revenue was approximately 25 percent of total Texas outpatient cancer treatment costs, this yielded an estimate of $1.427 billion in Texas in 1998.

As a check on the reasonableness of this number, we calculated outpatient treatment costs at M.D. Anderson Cancer Center to be about $480,735,000 in 1998. If this number is accurate it would account for about 34 percent of the outpatient cancer costs in the state, which we estimated by multiplying our estimate for Texas Oncology by four. The two entities between them would then account for almost 60 percent of all outpatient cancer treatment costs in Texas. We decided to use the figure of $1.427 billion as a reasonable estimate for outpatient treatment costs for cancer in Texas in 1998. This could not be broken out into the four main cancers of interest.

Emergency Services

The estimated cost of emergency services due to cancer, including both facility and physician costs, was about $17.7 million in 1998 (the estimate from MEPS was about $19 million—see Appendix A). Using the same ratio, estimated costs of emergency services were $1.54 million for persons with colorectal cancer, $2.18 million for lung cancer, $872,000 for breast cancer, and $938,000 for prostate cancer.

Home Health Care

There is a lot of variability in home care organizations and it is difficult to obtain the exact number in the state. The term "home care organizations" includes home health agencies, home care aid organizations, and hospices that provide home care (discussed in the next section). The Texas Cancer Data Center estimates that there were 900 Class A licensed and/or JCAHO accredited home health agencies in 1998.[44] According to the Health Care Financing Administration, there were 1,580 certified home health agencies in Texas in 1998.[45] According to the 1997 U.S. Economic Census, there were 2,473 businesses in Texas categorized as "home health care services" that were subject to federal income taxes, and 187 in this category that were tax-exempt, for a total of 2,660.[46] Some home care organizations choose not to participate in Medicare, and some, such as home care aid organizations that do not provide skilled nursing care, are not eligible to participate. Of Medicare-certified agencies nationwide in 1998, 42 percent were freestanding proprietary agencies, 29 percent were hospital-based, 12 percent were public agencies, 8 percent were private non-profits, and the remaining 9 percent were voluntary organizations, rehab-based, nursing-home based, or other types.[47]

Home health services are used by patients with acute illness, long-term health conditions, permanent disability, or terminal illness. Nationally in 1997, the sources of payment for home care were as follows: Medicare–39.5 percent, Medicaid–14.7 percent, state and local government–7 percent, private insurance–11.4 percent, out-of-pocket–22.3 percent, and other sources–12.2 percent.[48] HCFA estimates that the amount spent in Texas in 1998 by all payers for home health care was $2.862 billion.[49] Applying 8.3 percent (the percentage of people discharged from home health care with malignant neoplasms as their primary diagnosis) to the total cost of home health care gave an estimate of $237.5 million attributable to cancer (the MEPS estimate was $332.1 million—see Appendix A). Breaking this percentage down further by types of cancer produced numbers too small to be reliable.

Hospice Care

Hospices provide supportive care to terminally ill patients and their families. Hospices can be hospital-based (about 25 percent nationally in 1998), home health agency-based (about 35 percent), skilled nursing facility-based (about 1 percent), or freestanding (independent, usually non-profit—about 39 percent). Most if not all are certified by Medicare, and these are the ones with data available.[50] Hospices must be Medicare-certified (meet the Medicare conditions of participation) to receive payments under Medicaid as well as Medicare, and services are often provided in the patients' homes. Services also may be provided in a hospital or other inpatient facility, or in nursing facilities (reimbursed by Medicaid but not Medicare).[51] The sources of payment for hospice care in 1995 were Medicare (65.3 percent), Medicaid (7.8 percent), private insurance (12 percent), and indigent care and other sources (14.9 percent).[52]

In Texas in 1997, there were 150 Medicare-certified hospices serving 25,451 patients. Their total reimbursements in 1997 were $154,796,000 (from Medicare, Medicaid, or private insurance).[53] We obtained Medicare reimbursements for most Texas hospices for 1998, but could not obtain complete data so we used the 1997 data for this analysis.* In applying the national diagnosis data to the number of patients served by hospices in Texas in 1997, we estimate that 17,739 patients sought out hospice care due to some form of cancer. We could not break out colorectal cancer with the available data, but we calculated that 5,574 patients in Texas were served by hospices due to lung-related cancers, 1,120 due to breast cancer, and 840 due to prostate cancer. Applying the same percentages, we estimated that about $107.9 million was spent on hospice care for cancer patients in 1998. We cannot break out colorectal cancer costs, but we estimated that $33.9 million was spent due to lung-related cancers as the primary diagnosis, $6.8 million due to breast cancer, and $5.1 million due to prostate cancer.

Cancer Screening

Most people receive screening tests for one or more types of cancer as part of their routine physical examinations. For women these tests include mammograms for breast cancer, Pap smears for cervical cancer, and colonoscopies, sigmoidoscopies, and fecal occult blood tests for colorectal cancer. For men these include the prostate-specific antigen blood test (PSA) for prostate cancer and the same types of tests as women for colorectal cancer. Lung cancer screening is not routine for the general population.

The percentage of males and females age 40 and over reported having a fecal-occult blood test (FOBT) in the last year was 52.7 percent out of the 26.3 percent who had ever had one.[54] At an average cost of $11,[55] 1,013,402 people[56] receiving this test would cost about $11.1 million. We calculated that an estimated 100,440 people had a colonoscopy in 1998, so at an average cost of $1000 each,[57] the total cost for colonoscopies is estimated to be $100.4 million. The percentage of people who reported having a "sigmoidoscopy or proctoscopic exam" within the past year was 32.8 percent of the people who had ever had one (29.5 percent).[58] This equals about 707,475 people, and subtracting the people who had colonoscopies gives about 607,035 having sigmoidoscopies. Using an average cost of $237 for a sigmoidoscopy,[59] 607,035 people would cost about $143.9 million. Adding these three estimates gives a total cost of $255.5 million for colorectal cancer screening in 1998. Note that sigmoidoscopies and colonoscopies are not recommended to be given every year like the fecal occult blood test is (for people over 50), so this does not reflect the total number of people who may be following recommended guidelines.

There were 537 on-site mammography centers (approved by the American College of Radiology) in Texas in March of 1998.[60] In 1998 an estimated 1,945,139 women received mammograms (81.9 percent of women age 40 and over said they had "ever" had a mammogram, and 61.2 percent of these had one the previous year)[61] at an average cost of $106.[62] This gives an overall cost estimate of $206.2 million for mammograms in 1998. It was estimated that 2,365,657 women (73.8 percent of the 82.6 percent of women in Texas age 40 who had ever had a clinical breast exam) had a clinical breast exam in 1998.[63] We cannot assign an accurate cost to this component of breast cancer screening, as it is done by the

* We obtained Medicare reimbursements for 1998 through a Freedom of Information request to Palmetto GBA, the fiscal intermediary for a large majority of the hospices in Texas. The reports received had data for 142 hospices in Texas, with total charges of $91,407,312 and net reimbursements of $87,429,815 in 1998 (or parts of 1998, depending on the hospices' fiscal years). This is in line with the 1997 charges and reimbursements from NAHC if we assume Medicare is still the source for about 65 percent of payments, as noted for 1995.

physician as he/she is checking the rest of the body during a routine physical exam, but it generally takes only a few minutes so would not be a significant added cost.

Pap smears help detect early cervical cancer and pre-cancers and are one of the most effective cancer screening and prevention tools (cervical cancer incidence and deaths have decreased dramatically since the Pap test has become routine). In Texas for 1998, 66.4 percent of the 92.9 percent of women age 18 and over who reported ever having a Pap smear had one in 1998.[64] This translates to about 4,429,874 women.[65] At an average cost of $40,[66] the estimated total cost for Pap smears in 1998 was about $177.2 million. According to unpublished results from the Texas Department of Health's 1999 Behavioral Risk Factor Surveillance System survey, 30 percent of Texas men aged 40 and over (3,541,539) had a PSA test within the past year, equaling about 1,068,634 men.[67] The PSA test generally costs at least $25 per person,[68] so multiplying that cost by the number having the test equals about $26.7 million.

Retail Pharmaceuticals

In 1998, over 40,000 patients with a diagnosis of cancer were treated under Medicaid in Texas. The number of patients who obtained oncology drugs (see Appendix F for list of drugs) under the Medicaid Vendor Drug Program was 15,110, and the costs of these drugs for direct treatment was $9,643,368 in 1998. The total for other pharmaceuticals these same patients used for side effects and conditions related to the cancer and cancer treatment (see Appendix G for categories) was $9,801,254. Many other patients with a cancer diagnosis did not obtain their cancer-treatment drugs from the Vendor Drug Program (i.e., they obtained them in a hospital or doctor's office as opposed to a retail pharmacy), but did obtain related drugs through this program: an additional 26,776 patients with costs of $9,596,629 for related drugs. This brings the cost of oncology drugs plus related drugs obtained through the Texas Medicaid vendor drug program for these 41,886 patients to $29,041,251.[69]

This gives a total per capita estimated cost of relevant retail pharmaceuticals of $693.34 for these cancer patients getting drugs through Medicaid. An estimated 200,000 people in Texas received cancer treatments in 1998, so multiplying this number by the per capita estimated cost shown under Medicaid gives an estimate of $138.7 million for related retail pharmaceuticals for all cancer patients in Texas in 1998. Since the same drugs may be used to treat different cancers and side effects, we cannot use this data to assign specific costs to the four target cancers.

State Agency Budgets

Several state agencies are partially or totally devoted to cancer prevention, detection, and/or education, so we included their fiscal year 1998 budgets as a direct cost of cancer. These include the Texas Cancer Council with a FY98 budget of $4,002,544,[70] and several programs within the Texas Department of Health. These include the TDH Breast and Cervical Cancer Control Program with a FY98 budget of $5,239,818; the Cancer Registry Division (in the Bureau of Epidemiology), $1,669,089; the cancer prevention component of the Chronic Diseases Community and Worksite Wellness Division, $452,761; the cervical cancer component of the Maternal Health Program, $1,145,883; the Medical Transportation Program (has cancer transportation programs in seven Texas counties), $291,528; the Prostate Cancer

Education Program, $12,151; and the tobacco portion of the Bureau of Disease, Injury, and Tobacco Prevention with a budget of $1,271,179.[71] The total of these budgets for FY98 is $14,084,953, which is a conservative estimate as there are probably additional programs. This number cannot be reliably broken out into the four target cancers, since most budgets contain programs addressing several cancers or all cancers.

Non-Profits and Foundations

There are 124 foundations in the state of Texas that fund cancer research and/or treatment in some capacity. Although it is difficult to calculate their financial impact for various reasons, foundations as well as the non-profit sector are important components in cancer control in the state. With the rising numbers of cancer cases and treatment costs, these organizations will play a larger role in the cancer field. For example, in Austin there is research being done by a foundation to develop a community center for cancer patients and survivors that would offer activities such as support groups, exercise, and nutrition classes. Also, large organizations such as the American Cancer Society, the Susan G. Komen Foundation, and many others have contributed to research that has made a difference in the management and treatment of cancer.

For this study, we included only a few of the larger non-profits and foundations in Texas whose sole purpose is to serve cancer patients and survivors. These include the Lance Armstrong Foundation, with a 1998 budget of $344,622,[72] the Susan G. Komen Foundation, whose 1998 budget in Texas was $3,260,559,[73] and the American Cancer Society, whose 1998 Texas budget was $19,289,552.[74] The Candlelighters organization is very active in Texas, but their structure makes is difficult to determine costs. These three budgets total $22,894,773 for 1998. We cannot break out this amount by specific types of cancer as most organizations are concerned with more than one type of cancer.

Total Direct Costs and Breakdown

Using the numbers calculated in the preceding sections, we estimate the total direct cost of cancer in Texas in 1998 to be about $4.88 billion. We estimate that this includes at least $453 million attributable to colorectal cancer, $313 million to lung cancer, $325 million to breast cancer, and $152 million to prostate cancer, which are conservative estimates as many direct costs could not be broken out into these specific cancers. See Table 2 for details.

Table 2. Summary of Estimated Direct Costs of Cancer in Texas, 1998

Cost Component	Total, All Cancers (x $1,000)	Colorectal Cancer (x $1,000)	Lung Cancer (x $1,000)	Breast Cancer (x $1,000)	Prostate Cancer (x $1,000)
Hospitals	$1,852,574	$161,428	$228,049	$91,272	$98,157
Inpatient Physicians	$400,156	$34,868	$49,258	$19,715	$21,202
Emergency Services	$17,709	$1,543	$2,180	$872	$938
Outpatient Treatment	$1,427,000	n/a	n/a	n/a	n/a
Home Health	$237,546	n/a	n/a	n/a	n/a
Hospice Care	$107,893	n/a	$33,900	$6,811	$5,108
Cancer Screening	$665,551	$255,455	n/a	$206,185	$26,716
Retail Pharmaceuticals	$138,668	n/a	n/a	n/a	n/a
State Agency Budgets	$14,085	n/a	n/a	n/a	n/a
Nonprofits and Foundations	$22,895	n/a	n/a	n/a	n/a
TOTALS	**$4,884,077**	**$453,294**	**$313,387**	**$324,855**	**$152,121**

Note: "n/a" means "not available"

Findings: Indirect Costs

Morbidity/Disability

An estimated 247,000 Texans in 1998 had some history of cancer and an associated short-term or long-term disability (see Table 3). The estimated cost of that disability was about $4.1 billion in lost productivity. An estimated 46,000 women had some disability due to breast cancer, with an estimated cost of about $486 million. Disability due to lung cancer was less common (30,000), but the social cost was higher ($643 million). Disability from colorectal and prostate cancers cost about $283 million and $204 million respectively. Thus, the four specific types of cancer accounted for about 39 percent of the total disability costs of cancer in Texas.

The reader should note that the national survey data used for these estimates have relatively few respondents with any of the specific types of cancers studied, and even fewer have any associated disability. Thus, the confidence intervals associated with the cost estimates are quite wide.

Table 3. Estimated People Disabled due to Cancer and Costs of Lost Productivity, Texas, 1998

	Disabled due to Cancer			Lost Productivity	
	Persons	Prevalence	95% C.I.	Cost (x $1,000)	95% Relative C.I.
Any Cancer (ICD 140-208)	247,000	1.26%	+/-0.13%	$4,143,514	+/- 11%
Colorectal (ICD 153-4)	17,000	0.09%	+/-0.05%	$283,384	+/- 64%
Trachea, Bronchus, Lung (ICD 162)	29,000	0.15%	+/-0.06%	$642,817	+/- 43%
Female Breast (ICD 174)	46,000	0.23%	+/-0.07%	$486,444	+/- 29%
Prostate (ICD 185)	12,000	0.06%	+/-0.04%	$203,553	+/- 62%

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Notes:
"Any cancer" is defined as malignant neoplasms. However, in survey situations, respondents are likely to also report benign neoplasms.
Disability defined as unable to work, work loss days, or bed days with cancer as main cause.
Prevalence estimates for gender-specific cancers use total population as denominator.
C.I. = Confidence Interval.

Mortality

More than 32,000 people in Texas died from cancer in 1998, with the four specific cancers of interest accounting for more than half of the deaths (see Table 4). Lung cancer was by far the most common cause of death, and it accounted for about 30 percent of all cancer deaths. Cancer deaths in 1998 were associated with almost half a million years of life lost, with the four specific cancers accounting for half of the total. The reader should note that the specific types of cancer differ in terms of their impact on years of life lost. For example, the average death from breast cancer was estimated to result in 20 years of life lost, compared to prostate cancer where the average death resulted in about eight years of life lost.

The estimated 1998 present value of future losses in productively due to cancer mortality was almost $5 billion. About 25 percent ($1.2 billion) of the costs were associated with lung cancer. Colorectal and breast cancer cost about $460 million and $440 million, respectively. Prostate cancer had an estimated cost of about $90 million. Table 5 breaks this information out by public health region.

Table 4. Estimated Number of Deaths, Years of Life Lost, and Costs of Lost Productivity Due to Cancer Mortality in Texas, 1998, by Age Group

Age Group	All Cancers ICD 140-208	Colorectal ICD 153-4	Lung ICD 162	Breast ICD 174-5	Prostate ICD 185
Number of Deaths					
0-14	124	0	2	0	0
15-29	264	16	5	9	0
30-44	1,428	134	191	248	1
45-59	5,447	507	1,527	677	67
60-74	12,513	1,127	4,564	767	532
75+	12,499	1,492	3,224	786	1,295
Total	**32,275**	**3,276**	**9,513**	**2,487**	**1,895**
Years of Life Lost					
0-14	8,600	0	100	0	0
15-29	14,200	800	300	500	0
30-44	55,800	5,200	7,200	10,300	0
45-59	143,900	13,200	38,800	19,800	1,500
60-74	189,300	17,200	68,000	13,200	7,000
75+	68,900	8,400	17,500	4,800	6,300
Total	**480,700**	**44,800**	**131,800**	**48,500**	**14,800**
Costs of Lost Productivity (x $1,000)					
0-14	110,343	0	1,665	0	0
15-29	284,587	16,886	5,862	7,855	0
30-44	1,143,212	109,720	157,515	159,603	930
45-59	2,280,012	226,749	636,086	215,355	30,046
60-74	1,079,004	98,356	401,364	50,974	49,218
75+	77,665	8,978	20,594	3,950	9,571
Total	**$4,974,822**	**$460,689**	**$1,223,085**	**$437,737**	**$89,764**

Sources:
1998 population data: Texas State Data Center, Texas A&M University.
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Table 5. Number of Deaths, Years of Life Lost, and Estimated Costs of Lost Productivity Due to Cancer Mortality in Texas Public Health Regions, 1998

PHR	Cause	Deaths	Years of Life Lost	Costs
Region 1	All Cancer Deaths	1,422	19,300	$178,972,000
	Colorectal Cancer	147	1,800	15,544,000
	Lung Cancer	414	5,600	49,187,000
	Breast Cancer	105	1,800	14,838,000
	Prostate Cancer	108	800	5,177,000
Region 2	All Cancer Deaths	1,312	17,200	$154,287,000
	Colorectal Cancer	147	1,600	11,796,000
	Lung Cancer	398	5,000	39,198,000
	Breast Cancer	101	1,700	13,046,000
	Prostate Cancer	87	700	3,611,000
Region 3	All Cancer Deaths	7,583	118,000	$1,275,548,000
	Colorectal Cancer	832	11,900	130,238,000
	Lung Cancer	2,256	33,300	326,604,000
	Breast Cancer	582	11,700	109,742,000
	Prostate Cancer	417	3,300	20,857,000
Region 4	All Cancer Deaths	2,454	33,700	$328,769,000
	Colorectal Cancer	253	3,200	32,688,000
	Lung Cancer	795	10,800	103,571,000
	Breast Cancer	170	2,900	23,780,000
	Prostate Cancer	164	1,300	7,299,000
Region 5	All Cancer Deaths	1,916	26,900	$258,334,000
	Colorectal Cancer	172	2,200	19,922,000
	Lung Cancer	616	8,400	74,334,000
	Breast Cancer	107	2,000	17,433,000
	Prostate Cancer	121	900	5,270,000
Region 6	All Cancer Deaths	6,616	105,800	$1,174,907,000
	Colorectal Cancer	652	9,400	103,225,000
	Lung Cancer	2,005	29,600	295,035,000
	Breast Cancer	563	11,600	108,132,000
	Prostate Cancer	358	2,900	17,760,000
Region 7	All Cancer Deaths	3,349	48,500	$493,187,000
	Colorectal Cancer	362	5,000	53,289,000
	Lung Cancer	1,003	13,600	122,010,000
	Breast Cancer	257	5,100	47,039,000
	Prostate Cancer	195	1,500	8,683,000
Region 8	All Cancer Deaths	3,510	51,400	$520,490,000
	Colorectal Cancer	324	4, 000	36,869,000
	Lung Cancer	957	12,300	106,573,000
	Breast Cancer	276	5,300	48,120,000
	Prostate Cancer	203	1,600	10,148,000
Region 9	All Cancer Deaths	1,026	14,000	$123,387,000
	Colorectal Cancer	106	1,500	16,092,000
	Lung Cancer	317	4,200	33,666,000
	Breast Cancer	91	1,700	15,162,000
	Prostate Cancer	66	500	2,668,000
Region 10	All Cancer Deaths	924	15,000	$149,990,000
	Colorectal Cancer	95	1,400	13,746,000
	Lung Cancer	190	2,200	15,106,000
	Breast Cancer	85	1,600	13,266,000
	Prostate Cancer	51	300	1,410,000
Region 11	All Cancer Deaths	2,163	31,300	$316,952,000
	Colorectal Cancer	186	2,600	27,281,000
	Lung Cancer	562	6,900	57,802,000
	Breast Cancer	150	3,000	27,178,000
	Prostate Cancer	125	1,000	6,883,000

Findings: Total Estimated Economic Impact of Cancer in Texas in 1998

The total estimated cost of cancer in Texas in 1998 was about $14.0 billion, including direct costs of about $4.9 billion (see Table 2) and indirect costs of about $9.1 billion (see Table 3 for morbidity and Table 4 for mortality). This is broken out by the four most common cancers in Table 6. The distribution of costs for each of the types of cancer partly stems from the types of health care items measured in this study, and partly results from the nature of the diseases. Costs associated with lung cancer were largely associated with mortality and were proportionately small for medical treatment. Disability costs were proportionately high for prostate cancer and breast cancer.

Table 6. Summary of Estimated Total Costs of Cancer in Texas, 1998

	Direct Costs (x $1,000) and % of whole	Morbidity (x $1,000) and % of whole	Mortality (x $1,000) and % of whole	Total (x $1,000) and % of whole
Total, All Cancers	**$4,884,077 (34.9%)**	**$4,143,514 (29.6%)**	**$4,974,822 (35.5%)**	**$14,002,413 (100%)**
Colorectal Cancer	$453,294 (3.2%)	$283,384 (2.0%)	$460,689 (3.3%)	**$1,197,367 (8.6%)**
Lung Cancer	$313,387 (2.2%)	$642,817 (4.6%)	$1,223,085 (8.7%)	**$2,179,289 (15.6%)**
Breast Cancer	$324,855 (2.3%)	$486,444 (3.5%)	$437,737 (3.1%)	**$1,249,036 (8.9%)**
Prostate Cancer	$152,121 (1.1%)	$203,553 (1.5%)	$89,764 (0.6%)	**$445,438 (3.2%)**

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APPENDIX A

Data from the Medical Expenditure Panel Survey

The Medical Expenditure Panel Survey (MEPS) is a national survey of medical expenses among the U.S. population in 1996. The survey had a complex multi-stage sampling frame with 21,571 individuals participating. Of these, 1,089 had some history of cancer, including both malignant and benign conditions. When benign cancers are excluded, 777 individuals had some history of cancer.

Information from the survey is potentially useful for estimating some of the costs of cancer provided that the researcher is cognizant of the limitations of the data. First, there is the problem of sample size. The number of respondents with a history of cancer is reasonable for estimating total cost, and possibly reasonable for estimating costs for a particular payer or for a particular type of service. However, the number of respondents with a history of cancer who used a particular type of service and had coverage by a particular payer is likely to be very small. Also, the number of individuals with a history of a particular type of cancer may be small.

Second, there is the issue of transporting national survey data to Texas. The Texas population differs from the U.S. population, primarily because of the presence of the large Hispanic population. The cancer profile for Hispanic population is known to differ from that of the U.S. population in terms of incidence, access to care, and mortality.* Consequently, national survey data, however stratified, may not apply to the Texas population. Also, the structure of the Texas health care system differs from that of the U.S., and costs for the various services tend to be lower.

The following table provides cost estimates for cancer in Texas. The estimates are based on the U.S. national MEPS for 1996. Calculations are based on "attributable risk," that is, the calculations consider the differences in average cost between persons with and without a history of cancer. That difference is assumed to be attributable to cancer. The calculations are weighted to the U.S. national population in 1996, then adjusted to the Texas population estimated as of mid-1998. An additional adjustment considers that cancer incidence rates in Texas are about 85 percent of national figures, primarily because the Texas population is younger that the national population. No adjustment is made to inflate cost figures from 1996 to 1998, nor for the relative costs of care in Texas and the U.S., primarily because those two items will balance each other out, and also because such adjustments would presume levels of accuracy and precision which do not exist. Also, the tables do not provide confidence intervals, primarily because such calculations would apply to the U.S. population and not necessarily to the Texas population.

**See, for example:*

Markides, Kyriakos S., and Jeanine Coreil. "The Health of Hispanics in the Southwestern United States: An Epidemiological Paradox." *Public Health Reports,* 101 (May-June 1986), pp. 253-265.

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Appendix A, continued

The reader will note that some cells contain negative numbers. It is possible that a person with cancer might cause a shifting of costs. For example, an individual with Medicaid who is diagnosed with cancer might become eligible for Medicare, thus resulting in a net saving to Medicaid. More likely, however, the negative numbers result simply from sampling error and the formula employed for calculating attributable risk.

Estimated Attributable Costs of Cancer in Texas, 1998

	Private Insurance	Medicare	Medicaid	Other	Total	Percent
PERSONS WITH ANY CANCER HISTORY						
Hospital Inpatient Facility	650,116,956	1,098,901,213	200,427,041	36,746,797	**1,986,192,007**	46%
Hospital Inpatient Physician	131,117,824	63,101,950	13,160,451	9,628,209	**217,008,434**	5%
Hospital Outpatient Facility	205,585,922	144,823,176	3,271,618	78,398,403	**432,079,119**	10%
Hospital Outpatient Provider	68,984,935	53,559,352	2,522,691	12,318,815	**137,385,792**	3%
Hospital Emergency Facility and Physician	1,093,025	28,264,191	-1,503,415	-8,867,865	**18,985,936**	0%
Office-Based - Physician and Non-Physician	337,527,880	209,951,528	5,673,219	105,222,024	**658,374,650**	15%
Home Health	28,760,912	171,469,470	13,549,626	118,314,284	**332,094,293**	8%
Equipment/Supplies	23,219,251	19,206,943	-151,432	36,091,641	**78,366,404**	2%
Prescriptions	155,317,001	9,841,884	3,824,812	182,091,843	**351,075,540**	8%
All Other	18,662,764	769,391	-3,252,106	99,305,005	**115,485,054**	3%
Total	**1,620,386,469**	**1,799,889,098**	**237,522,505**	**669,249,155**	**4,327,047,228**	100%
Percent	37%	42%	5%	15%	100%	

PERSONS WITH ANY NON-BENIGN CANCER HISTORY						
Hospital Inpatient Facility	625,153,864	1,119,675,055	216,727,964	28,263,234	**1,989,820,116**	50%
Hospital Inpatient Physician	123,350,285	65,405,551	14,603,405	6,454,916	**209,814,156**	5%
Hospital Outpatient Facility	169,709,030	135,774,241	3,734,104	70,335,868	**379,553,243**	10%
Hospital Outpatient Provider	49,354,707	50,131,572	2,669,692	8,808,625	**110,964,596**	3%
Hospital Emergency Facility and Physician	2,821,215	28,838,813	33,055	-6,475,135	**25,217,948**	1%
Office-Based - Physician and Non-Physician	252,180,927	201,664,802	11,896,440	80,841,293	**546,583,462**	14%
Home Health	31,377,768	186,969,175	19,043,766	112,339,002	**349,729,711**	9%
Equipment/Supplies	23,156,564	19,637,477	685,661	30,125,726	**73,605,429**	2%
Prescriptions	124,026,878	4,263,246	8,310,437	154,039,286	**290,639,847**	7%
All Other	-4,707,910	772,561	-2,109,046	15,430,965	**9,386,569**	0%
Total	**1,396,423,328**	**1,813,132,492**	**275,595,478**	**500,163,780**	**3,985,315,078**	100%
Percent	35%	45%	7%	13%	100%	

Source: U.S. Medical Expenditure Panel Survey, 1996.

APPENDIX B

Review of SAMMEC Methodology

The Smoking-Attributable Mortality, Morbidity, and Economic Costs (SAMMEC) software package was developed by the Office of Smoking and Health of the National Center for Chronic Disease Prevention and Health Promotion at the CDC. The package was developed to help states and large cities to estimate the effects of smoking. The software addresses cancer costs when attributable to tobacco, but it does not directly deal with costs of cancers due to other causes.

In the current version 3.0, the software can be used to estimate smoking-attributable mortality, years of life lost, and costs of premature mortality. The economic portion of the calculations employs the "human capital approach" in that loss in life is valued in terms of present value of future losses in productivity if the deceased had survived to average life expectancy. Future versions of the software will address lost productivity from disability and direct costs of health care attributable to smoking.

The software comes with a complete set of raw data for the United States overall, but would need addition of data specific to Texas. It employs a set of input tables to generate output tables, and it offers some graphic output as well. The following are descriptions of the input tables:

- Study population by gender in 5-year age groups beginning at age 35.
- A standard population for comparisons, also by gender and 5-year age groups.
- Years of potential life remaining in the study population for the same groups.
- Number of deaths from 27 causes of death by gender and age groups, including infants for five causes and persons under age 35 for burns. The causes of death include eight categories of cancer. Causes of death not strongly associated with smoking are not included in the table.
- Current and former smoking prevalence estimates for men and women, and for ages 35-64 and 65 and over, respectively; also includes smoking prevalence among pregnant women.
- Relative risk estimates for male and female current and former smokers (and for infants) for the various causes of death.
- Estimates of present value of future earnings by gender and 5-year age groups. The estimates employ a discount rate of 2 percent and assume a 1 percent annual increase in productivity.

For use in Texas, some modification of the raw data would be necessary. However, most of the needed information is readily available: population, deaths, and life expectancy data. Smoking prevalence estimates for Texas can be drawn from the Behavioral Risk Factor Survey. Relative risk data need not be modified. Some adaptation would be needed to generate lifetime earning figures appropriate to Texas.

The major output tables are the following:

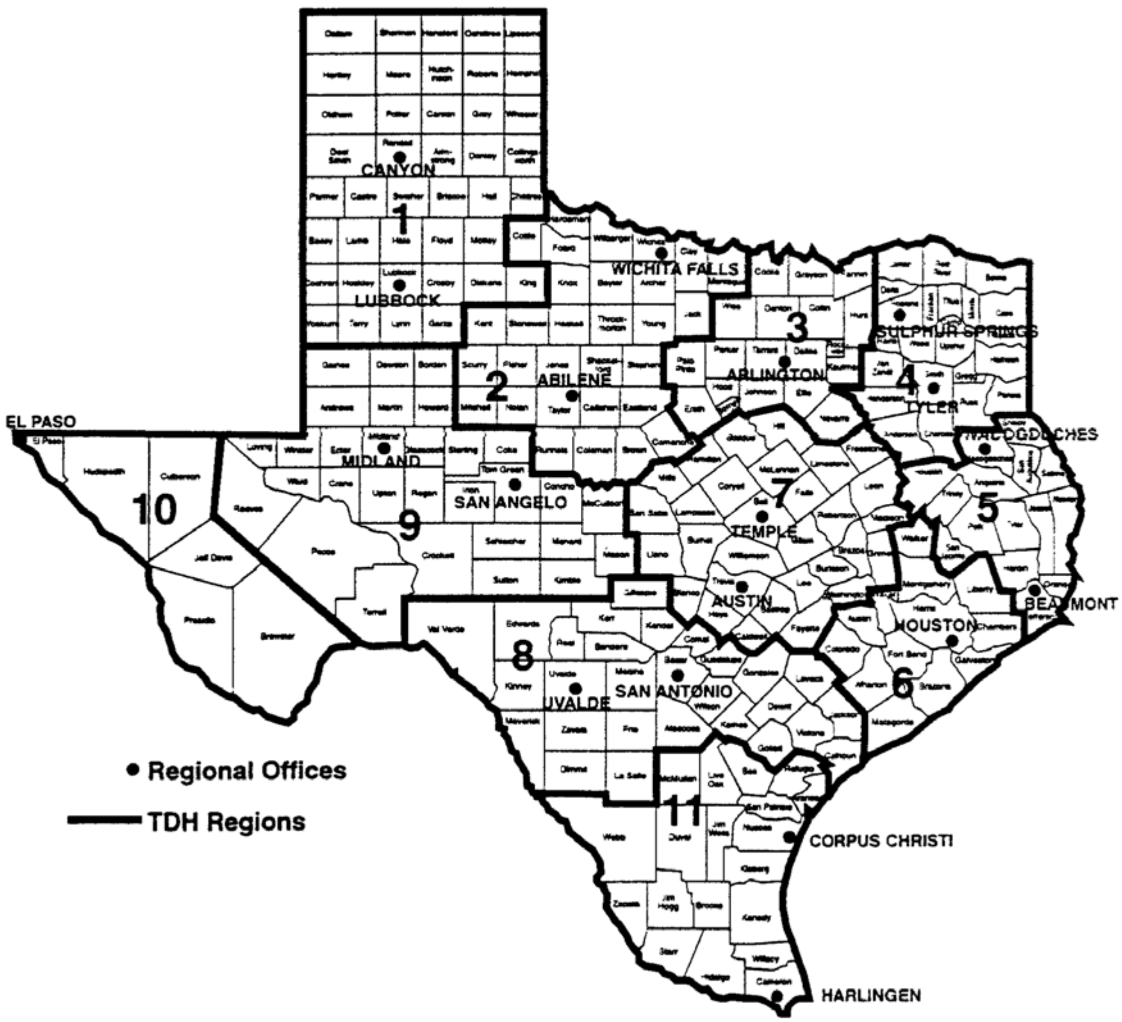
- Number of smoking-attributable deaths by cause, age, and gender (including rates, and fractions of all deaths within the listed causes).
- Years of potential life lost by cause, age, and gender (including standardization against a comparison population).
- Smoking-attributable costs by cause, age and gender.

The software has some limitations. The documentation advises that the calculations should not be applied to populations smaller than 500,000, and suggestion is made that multi-year averages can yield more stable estimates. A particular concern is that the software does not deal with statistical errors that might arise from the estimates of smoking prevalence and from the relative risk figures. Thus, the output does not provide confidence intervals. Finally, there is some potential for error arising from the relative risk figures to the extent that the relative risks in Texas differ. For example, a higher mortality from cervical cancer, even in the absence of smoking, might mean that the relative risk for smoking-attributable cervical cancer differs from the figures provided with the software package. Nevertheless, even if cervical cancer risk is higher, it is also likely that smoking increases the risk proportionately.

As explained earlier, the software does not directly estimate costs for all deaths from a given cause, say, lung cancer.

APPENDIX C

Map of Texas Department of Health Public Health Regions



APPENDIX D

Ratios of Medicare Inpatient Physician to Facility Costs for Selected DRGs

DRG	N	Mean	Std Deviation
1	1264	0.2620	0.1456
10	646	0.2607	0.1576
75	1405	0.2259	0.1037
76	1359	0.2151	0.1042
82	2087	0.2321	0.1345
89	13654	0.1854	0.1028
148	4464	0.2074	0.0998
172	960	0.2320	0.1294
173	73	0.2525	0.1613
188	2410	0.2546	0.1438
203	922	0.2315	0.1253
237	55	0.3060	0.1769
238	233	0.2029	0.1332
239	1711	0.2396	0.1343
296	6856	0.2285	0.1333
303	666	0.2817	0.1226
358	710	0.3057	0.1413
359	861	0.3694	0.1525
395	2347	0.2184	0.1410
398	628	0.1609	0.1117
403	1183	0.2048	0.1347
410	1638	0.1230	0.1046
416	6325	0.2005	0.1168
481	10	0.0517	0.0267
492	105	0.0675	0.0426

Source: Zwanziger, Jack, Associate Professor, Department of Community and Preventive Medicine, University of Rochester. Personal e-mail to David C. Warner. January 1, 2001.

Note: "N" refers to the number of cases employed in the source study, not to the number of hospital cases in Texas.

APPENDIX E

Freestanding Cancer Centers in Texas, March 1998

Cancer Center	City
North Texas Cancer Treatment Center	Denton
El Paso Cancer Treatment Center	El Paso
Arlington Cancer Center	Arlington
Shivers Cancer Center	Austin
Cancer Therapy and Research Center	San Antonio
Allison Cancer Center	Midland
The Don and Sybil Harrington Cancer Center	Amarillo
M.D. Anderson Cancer Network—Tarrant County	Fort Worth
Austin Cancer Center	Austin
Houston Northwest Radiotherapy Center	Houston
Live Oak Regional Cancer Center	San Antonio
Regional Cancer Treatment Center	San Angelo
North Texas Regional Cancer Center	Plano
Cancer Center of Port Arthur	Port Arthur
Radiation Therapy Center	Houston
Kelsey-Seybold Cancer Prevention Center	Houston
Texas Cancer Center-Sherman	Sherman
Northwest Outpatient Cancer Center	Houston
St. Joseph Regional Cancer Center	Bryan
Kerrville Radiation Therapy Center	Kerrville
Houston Cancer Institute	Houston
Bellaire Cancer Treatment Center	Houston
Paris Regional Cancer Center	Paris
Southwest Regional Cancer Center	Austin
Brazosport Cancer Center	Lake Jackson
Texas Oncology Physician Associates	Dallas
South Texas Cancer Center	McAllen
Longview Cancer Center	Longview
North Austin Cancer Center	Austin
Texas Cancer Center—Abilene South	Abilene

Source: Texas Cancer Data Center

APPENDIX F

Oncology Drugs included in Retail Pharmaceutical Costs

American Hospital Formulary System Code 100000

Aclarubicin HCL
Aldesleukin
Altretamine
Amsacrine
Anastrozole
Asparaginase
Bendamustine HCL
Bexarotene
Bicalutamide
Bleomycin Sulfate
Bleomycin Sulfate/Lidocaine HC
Buserelin Acetate
Busulfan
Capecitabine
Carboplatin
Carmustine
Carmustine/Polifeprosan 20
Chlorambucil
Cisplatin
Cladribine
Corynebacterium Parvum
Cyclophosphamide
Cyclophosphamide/Dex-Water
Cyclophosphamide/Na Chlor 0.9%
Cyproterone Acetate
Cytarabine
Cytarabine Liposome
Dacarbazine
Dactinomycin
Daunorubicin Citrate Liposomal
Daunorubicin HCL
Denileukin Diftitox
Dhs/Phthalylsulfathiazole/Niac
Docetaxel
Docetaxel Anhydrous
Doxorubicin HCL
Doxorubicin HCL Liposomal
Dromostanolone Propionate
Elliptinium Acetate
Epirubicin HCL
Epirubicin HCL/Ethiodized Oil
Erwinia Asparaginase
Estramustine Phosphate Sodium
Ethoglucid
Etoposide
Etoposide Phosphate
Exemestane
Floxuridine
Fludarabine Phosphate
Fluorouracil
Flutamide
Formestane
Fotemustine
Gemcitabine HCL
Gemtuzumab Ozogamicin
Goserelin Acetate
Hydroxyurea
Idarubicin HCL
Ifosfamide
Ifosfamide/Mesna
Interferon Alfa-2a,Recomb.
Interferon Alfa-2b,Recomb.
Interferon Alfa-N1
Interferon Alfa-N3
Interferon Alfacon-1
Interferon Gamma-1b,Recomb.
Irinotecan HCL
Letrozole
Leuprolide Ac (Obsolete)
Leuprolide Acetate
Levamisole HCL
Lomustine
Mechlorethamine HCL
Megestrol Acetate
Melphalan
Melphalan HCL
Mercaptopuril
Methotrexate
Methotrexate Sodium
Mistletoe
Mitobronitol
Mitomycin
Mitotane
Mitoxantrone HCL
Na Rep 0.9%/Bcg Vaccine
Nilutamide
Nimustine HCL
Oxaliplatin
Paclitaxel
Paclitaxel,Semi-Synthetic
Pegaspargase
Pentostatin
Pipobroman
Pirarubicin
Plicamycin
Porfimer Sodium
Prednimustine
Procarbazine HCL
Raltitrexed
Razoxane
Rituximab
Streptozocin
Tamoxifen Citrate
Tegafur
Tegafur/Uracil
Temozolomide
Teniposide
Testolactone
Thioguanine
Thiotepa
Topotecan HCL
Toremifene Citrate
Trastuzumab
Treosulfan
Tretinoin
Triptorelin
Triptorelin Acetate
Trofosfamide
Trypsin/Chymotrypsin/Papain
Uracil Mustard
Valrubicin
Vinblastine Sulfate
Vincristine Sulfate
Vindesine Sulfate
Vinorelbine Tartrate

APPENDIX G

Other Drugs Related to Cancer and Treatment included in Retail Pharmaceutical Costs

American Hospital Formulary System Code and Description

081202	aminoglycosides
081204	antifungal antibiotics
081206	cephalosporins
081207	b-lactam antibiotics
081212	macrolides
081216	penicillins
081224	tetracyclines
081228	miscellaneous antibiotics
082200	quinolones
082400	sulfonamides
082600	sulfones
083600	urinary anti-infectives
200404	iron preparations
201204	anticoagulants
201216	hemostatics
201600	hematopoietics
280804	nsaids
280808	opiate agonists
280812	opiate partial agonists
280892	miscellaneous analgesics
281000	opiate antagonists
281204	barbiturates
281208	benzodiazepines
281212	hydantoins
281220	succinimides
281292	miscellaneous anticonvulsants
282492	miscellaneous anxiolytics
400400	acidifying agents
400800	alkalinizing agents
401000	ammonia detoxificants
401200	replacement preparations
401800	potassium-removing resins
402000	caloric agents
402400	salt and sugar substitutes
520405	antifungals
560800	anti-inflammatory agents
561200	cathartics and laxatives
561400	cholelitholytic agents
561600	digestants
562200	antiemetics
680400	adrenals
840404	skin anti-infectives

COMPREHENSIVE CANCER CONTROL PROGRAM

http://www.tdh.state.tx.us/tcccp

The Cost of Cancer in Texas

A Report to the
Texas Comprehensive Cancer Control Coalition
on the Economic Impact of Cancer

by
The Lyndon B. Johnson School of Public Affairs,
The University of Texas at Austin
and the
Texas Health Care Information Council

- **Executive Summary**
  Philip Huang, M.D., M.P.H., *The Texas Department of Health*

- **Direct and Indirect Costs, 1998**
  Roy R. McCandless, M.A., M.P.A., Dr.P.H.
  Lauren Rivera Jahnke, M.P.Aff.
  David C. Warner, Ph.D.
  Sarah Widoff
  The Lyndon B. Johnson School of Public Affairs

  Michael Johnsrud, Ph.D., R.Ph.
  The Center for Pharmacoeconomic Studies,
  The University of Texas at Austin

- **Literature Review and Analysis on Cancer Prevention and Cost-Effectiveness**
  Lauren Rivera Jahnke, M.P.Aff.
  David C. Warner, Ph.D.

- **Hospital Inpatient Costs of Cancer in Texas**
  Researchers:
  Roy R. McCandless, M.A., M.P.A., Dr.P.H.
  David C. Warner, Ph.D.
  Zhongmin Li, Ph.D., *Texas Health Care Information Council*

– 2nd edition –

Literature Review and Analysis on Cancer Prevention and Cost-Effectiveness

Table of Contents

The Cost of Cancer in Texas

Literature Review and Analysis on Cancer Prevention and Cost-Effectiveness

Introduction

Cancer is a group of related diseases that involve uncontrolled growth and spread of abnormal cells. In Texas in 1998, 32,275 people died from cancer. Of these cancer deaths, 9,513 were attributed to lung cancer, 2,487 to breast cancer, 1,895 to prostate cancer, and 3,276 to cancers of the colorectal system; these four types of cancer accounted for 53.2 percent of all cancer deaths. The top cancer killer of both men and women was cancers of the lung, trachea, and bronchus, while the second most-fatal was prostate cancer for males and breast cancer for females.[1] It is estimated that 1,220,100 new cases of cancer will be diagnosed in the United States in 2000, with 74,359 of these new cases in Texas.[2] Of the U.S. population, it is estimated that half of all men and one-third of all women will develop cancer in their lifetimes, and millions of people are living with cancer or are considered cured.[3] Some of these cancers are completely preventable, and the financial, physical, and emotional impact of many others could be lessened if more people practiced prevention and early detection measures.

“Primary prevention” refers to efforts to prevent cancer from developing, such as avoiding known risk factors, like smoking, and taking measures to lower one’s risk, such as regular exercise and healthy eating habits. “Secondary prevention,” also called early detection or screening, includes testing to locate the presence of cancerous cells as early as possible, while they are still localized and can be treated most effectively. There has been much research, discussion, and debate among health professionals regarding cancer prevention. Issues with primary prevention include identifying cancer-causing agents and determining how much exposure causes health risk in humans, and how to persuade people to avoid risky activities if they are associated with pleasure and would require behavioral changes, such as quitting smoking or limiting exposure to the ultra-violet rays in sunlight. Issues with secondary prevention include how much invasive medical testing should be done on asymptomatic individuals, which individuals should be targeted for screening and what are the optimal intervals, which tests are most effective, and which costs can be justified when most people screened will test negative for cancer and some tests may have harmful side effects.

The following sections discuss cancer prevention and early detection guidelines, strategies, and issues, including details on lung cancer, breast cancer, prostate cancer, colorectal cancer, and others as appropriate. Information is also included on analyzing the cost-effectiveness of prevention efforts, and the last section discusses issues in calculating the economic impact of primary and secondary prevention.

Primary Prevention

Guidelines and Strategies

As "cancer" actually consists of more than 100 different diseases in all parts of the body, there is no concise way to describe prevention and early detection methods for all of them, and a wealth of information is already freely available on these topics. Although genetics is a factor in the development of many cancers, heredity alone does not explain cancer; behavioral factors modify the risk of cancer at every stage. Evidence shows that about one-third of the approximately 500,000 annual cancer deaths in the U.S. is due to cigarette smoking and another third is due mainly to dietary factors; the remaining third is influenced by many factors including sun exposure, hormones, infections, and occupational hazards.[4] Since a majority of the population does not smoke, nutrition and physical activity are the most important overall behavioral determinants of cancer risk in the general population.[5]

Only 10 to 20 percent of all cancers are caused by inherited mutations (present in almost all cells in the body from birth) and naturally-occurring somatic mutations (mistakes in cell division occurring after birth, so present only in the cells descending from the mutated cell). The other 80 to 90 percent of cancer cases are caused by somatic mutations of cancer-related genes that happen due to environmental exposure to cancer-causing agents, or carcinogens. It has been determined that five or more genes must be mutated before malignant transformation starts in most adult cancers, but as few as two mutated genes may cause some childhood cancers.[6] As carcinogenesis, the process of developing cancer, becomes more understood, it is hoped that genetic therapies will be developed that can interfere in key steps of this process or undo damage to cells. Until this happens, the only known activities that might aid in the prevention of cancer are decreasing exposure to carcinogens (avoiding them and imposing restrictions on their production), increasing exposure to beneficial chemicals, and detecting and treating precancerous conditions early.

Cancer risk is affected by many dietary factors, such as types of food eaten, how the food was prepared, portion size, and overall caloric balance. Limiting meat, dairy, and other high-fat foods; and eating more plant-based foods such as fruits, vegetables, beans, and grains; and balancing calories and physical exercise can reduce cancer risk, but many Americans do not follow these principles. The American Cancer Society Advisory Committee on Diet, Physical Activity, and Cancer put forth guidelines in 1998 for people age 2 and over to reduce cancer risk (see Table 1). Though no diet can guarantee complete defense again a disease, these guidelines are based on scientific studies and are consistent with other health agencies' recommendations on healthful practices and the prevention of other diet-influenced conditions such as heart disease and diabetes.[7] The National Cancer Institute, Department of Agriculture, and other organizations also have similar dietary guidelines.

Table 1. American Cancer Society Guidelines on Diet, Nutrition, and Cancer Prevention

1. Choose most of the foods you eat from plant sources.
   - Eat five or more servings of fruits and vegetables each day.
   - Eat other foods from plant sources, such as breads, cereals, grain products, rice, pasta, or beans several times each day.
2. Limit your intake of high-fat foods, particularly from animal sources.
   - Choose foods low in fat.
   - Limit consumption of meats, especially high-fat meats.
3. Be physically active: achieve and maintain a healthy weight.
   - Be at least moderately active for 30 minutes or more on most days of the week.
   - Stay within your healthy weight range.
4. Limit consumption of alcoholic beverages, if you drink at all.

Source: ACS, "The Importance of Nutrition In Cancer Prevention," http://www2.cancer.org/prevention/NutritionandPrevention.cfm.

Many studies have shown an association between lack of adequate consumption of fruits and vegetables and increased risk of many cancers as well as other conditions like cardiovascular disease. The quarter of the population with the lowest intake of fruits and vegetables was shown to have about twice the rate for most common types of cancer than the quarter with the highest intake. The benefits are thought to be due to antioxidants and other beneficial micronutrients that can help to repair DNA damage.[8] Conversely, a high-fat and high-calorie diet and the resulting effects on obesity and hormone production has been linked to several cancers, including those of the breast, prostate, ovary, and endometrium. Though dietary factors are important in many cancers, few of these have been unequivocally linked to specific human cancers. Therefore, while the above guidelines and others can be recommended for overall good health and cancer prevention, it is not possible to recommend certain foods or physical activities to specifically prevent breast cancer, prostate cancer, or most others. However, specific primary prevention measures can be effective in at least several cancers, including skin, colorectal, and lung cancers.

The main prevention for melanoma and other skin cancers is limiting exposure to ultraviolet (UV) light in sunlight and tanning booths, especially for people with light skin (people with dark pigment have a low incidence of skin cancer). Protective clothing and avoiding sun exposure in the middle of the day is recommended, and though the exact effect of sunscreen is not known, it does prevent serious sunburns associated with melanoma. Therefore, it is recommended that people use a water-resistant sunscreen with a sun-protection factor (SPF) of at least 30 when outdoors.

Several studies have shown that NSAIDs (nonsteroidal anti-inflammatory drugs, like aspirin and ibuprofen) may prevent colorectal cancer.[9] Not enough evidence currently exists for aspirin to be recommended to everyone for this purpose, but people at high risk or others who are interested might want to consider taking one aspirin per day (which may also help prevent heart attacks and strokes). Though evidence for a protective effect of dietary fiber against colon cancer has been shown in comparative studies and animal studies,[10] this is not completely conclusive or understood, as several recent studies have shown no significant effect, and that a certain type of fiber (found in some supplements but not in the average diet) may even increase the incidence of malignant colon tumors in people with adenomas (precancerous growths).[11] Extra calcium may also help prevent colorectal cancer, but this is still under investigation.

Tobacco smoke is a major cause of cancer deaths, as stated above. It is estimated that smoking accounts for 80 to 90 percent of lung cancers, so smoking cessation and tobacco control are obvious and effective prevention measures for lung cancer. Lung cancer is unique in that it has an obvious etiology and clear risk reduction actions for a majority of the cases, yet economic, political, and social factors make control difficult.[12] In the early 1900s, before the introduction and widespread availability of manufactured cigarettes, lung cancer was rare. Smoking is also associated with cancers of the oropharynx, esophagus, pancreas, kidney, bladder, and cervix. It is estimated that 91 percent of adult smokers had their first cigarette before age 20, and smoking among youth is increasing even as it decreases among the general population.[13] About 3 million (22 percent) adults in Texas over age 18 smoked cigarettes in 1998, and this number increases when other forms of smoking and those under 18 are taken into account.[14]

More than 3500 chemicals and more than 55 potential carcinogens have been identified in tobacco smoke.[15] The longer a person has smoked and the more packs a day smoked, the greater the risk of getting lung cancer. The lungs of people who quit smoking gradually start returning to normal, though after 10 years they are still at higher risk for lung cancer than a person who never smoked, and their risk for lung cancer as well as heart disease remains higher for as long as 25 years.[16] Exposure to second-hand smoke also increases the risk of lung cancer; a spouse of a smoker has a 30 percent higher risk of developing lung cancer than a spouse of a nonsmoker. Marijuana cigarettes have more tar than regular cigarettes and thus are also a risk, though it is difficult to obtain clear data because they are illegal and unregulated, and also many people who smoke them also smoke tobacco, making it hard to differentiate the effects.[17] One effect of smoking that many people do not know or do not consider is that men who smoke (as well as those with inadequate diets such as a vitamin C deficiency, which is sometimes linked to smoking) may cause damage to not only their somatic DNA but the DNA in their sperm. Therefore, smoking by fathers-to-be may increase the risk of birth defects and childhood cancers in their children.[18]

Personal and family history of lung cancer is a risk factor, though in families with smokers it is difficult to tell if the increased risk is due to heredity or exposure to smoke. The lung cells of women may have more of a genetic predisposition to develop cancer when exposed to tobacco smoke than men, several studies have shown, thus women may be more likely to develop lung cancer than men under the same circumstances. People acquire mutations all the time, from environmental factors and as cells reproduce and damage to DNA occurs, however, most of these are corrected by repair enzymes and many are harmless. But if cells are exposed to too many carcinogens, such as from tobacco smoke, they may be weakened or be growing too fast, and all mutations may not be fixed. Cancerous tumors can form in the lungs (as well as other areas of the body), and other mutations may make some cancers likely to spread faster and become more invasive.[19]

Another risk factor for lung cancer is exposure to asbestos fibers, which can cause a cancer of the pleura called mesothelioma. Asbestos workers are seven times more likely to die of lung cancer than the general population, and asbestos workers who smoke have a greatly increased risk of getting lung cancer—50 to 90 times greater than the general population.[20] Radon, a naturally-occurring gas formed from radium during the decay of uranium, can increase risk for lung cancer. Radon outdoors is not a problem, but it can become concentrated indoors when it diffused through the ground up into basements and walls and becomes trapped in homes in some regions. Increased risk also results from other gases and chemicals that miners and other workers may be exposed to such as uranium, arsenic, vinyl chloride, mustard gas, talc, and coal products.

The inflammation and scarring caused by tuberculosis and some types of pneumonia can cause increased risk of adenocarcinoma. Air pollution was estimated to cause 1 to 2 percent of all lung cancers, and this will decrease as more attention is paid to the environment, thus pollution is not felt to be an important factor in lung cancer.[21] Most other chemicals found in water pollution and foods are also not a significant cause of cancer. It is estimated that more than 99 percent of the chemicals that people ingest, including pesticides, are natural and not synthetic in origin, and that at least half of all chemicals that have been tested, whether natural or man-made, and even those that occur in fruits and vegetables, can be shown to be carcinogenic in rodents if given in high enough doses. There is growing evidence that this carcinogenicity is due to the high dose itself (much higher than a human would ever ingest) causing tissue injuries and more rapid cell division, and later cancer, and not the chemical itself.[22]

Quitting smoking is the most obvious prevention strategy for most lung cancers, and another important strategy is for people who work around substances that may cause cancer to take appropriate protective measures. People living near natural uranium deposits should get their homes tested for radon gas. Even if all of these risk factors are minimized, there will still be some people who develop lung cancer for no apparent reason. These cases could perhaps be minimized if more people followed the general guidelines for good health and diet and lowering one's cancer risk from the American Cancer Society and others, as stated above. A newer area of research is chemoprevention, the use of natural or synthetic chemicals to prevent, inhibit, or reverse cancer. The National Cancer Institute is currently studying over 450 compounds in the laboratory, and about 40 in clinical trials. The four categories of preventive agents with the highest priority for research are nonsteroidal anti-inflammatory drugs (NSAIDs like aspirin, as mentioned above in connection with colorectal cancer), calcium compounds, retinoids (which are related to vitamin A), and hormonal agents such as selective estrogen receptor modulators (SERMS, such as tamoxifen and raloxifene).[23] These drugs show promise in fighting some cancers, but the effects are complicated and may not be clear-cut. For example, tamoxifen was shown to decrease the risk of breast cancer in high-risk women, but it increased the risk of endometrial cancer, and vitamin A and beta carotene were tested as preventive agents for lung cancer but both were found to actually increase the risk of lung cancer among smokers. Much more research is needed in the area of chemoprevention, and the current clinical trials and their results will take many years to complete and analyze.

Important Issues with Primary Prevention

Primary prevention sounds simple in theory but is actually a very complex area to study. When real people are involved there are many variables to control that could be helping to cause or inhibit the effect, in this case the development of cancer. There are many biological processes and relationships that are not fully understood, since people that are apparently very healthy can develop cancer, and others with unhealthy habits may never get cancer. Results that hold true in chemical tests or in laboratory animals may not be the same in humans, and even if they are, they could take many years to appear, as cancer becomes more likely as a person ages. Clinical trials (meaning human subjects) are difficult to manage because thousands of subjects must be recruited and enrolled into studies to demonstrate risk reduction, and they must be monitored for many years. Even in non-clinical prevention efforts like education programs, results will not be seen overnight. It is estimated that it takes 20 to 30 years to see a decline in lung cancer rates after smoking declines in a population.[24] Prevention is best thought of in the context of long-term goals, and there are no guarantees with current prevention methods, only the promise to "reduce" risk.

Cost-Effectiveness of Primary Prevention

Cost-effectiveness of primary prevention is difficult to calculate due to the reasons stated above. Since the timeframe is very long term (preventing cancer over a person's entire lifetime), many other variables come into play, both known and unknown, and these could also affect other conditions like heart disease, making it difficult to quantify and separate the effects of prevention measures. Since the intervention often occurs early while the health benefits usually happen later in life, it is necessary to apply a discount rate to the future benefits and costs so that all amounts are expressed in the present value. Because of this discounting, prevention with shorter-term benefits and savings will often have more favorable cost-effectiveness ratios than preventive measures with longer-term benefits and savings.[25] By the same token, prevention often gets short shrift compared to treatment because treatment is for identifiable individuals in the present while prevention is for statistical individuals with benefits to be realized in the future.

Many primary prevention initiatives such as physical education in schools, dietary advice, and promotion of protected sex are not likely to be found particularly cost effective in themselves if the only benefits one is measuring are the reduction of morbidity and mortality due to cancer. They have an impact over many years, whole populations receive them, and only a small number of cancer sufferers will be affected. This is not to say that these are not worthwhile initiatives. Other benefits such as reduction in heart disease, stroke, diabetes, and other conditions may also occur due to these initiatives and should also be figured into the calculus.

To calculate the cost effectiveness of a particular initiative, say the health gains of banning junk food from public schools, one would have to make the following calculations using what has become standard cost-effectiveness methodology:[26]

(1) The net cost of the action proposed; this should include the discounted present value of the incremental cost of this action now and in the future. In this example it might require the cost of hiring additional school cafeteria personnel and foregoing contributions to the school by snack food and beverage companies. This might require raising taxes or spending less on other programs. If we are looking at the intervention from the point of view of society, then savings to children and families of not buying junk food at school should be factored in.

(2) The costs to be measured should be related to the population being studied. For instance, if we are looking at the school population who would be in first grade in 2001, then we would apportion the net present value of cafeteria costs to the school for that population for the next 12 years. From these costs we can subtract the present value of the net change in treatment costs over a lifetime that would be averted due to improved nutrition during school years.

(3) The effectiveness part of the equation estimates the change in discounted quality-adjusted life years from the initiative. Since the health benefits will be realized far into the future and discounted to the present, the calculations will be difficult. The improved nutrition depends on the quality of food that these children consume after the change, and many children will continue to eat unhealthy food elsewhere. The exact link between childhood nutrition and specific health outcomes is difficult to establish. Similarly, the course of these outcomes is difficult to date, cost, and predict. In any case, in this and similar analyses the indirect cost of cancer or other diseases are not included in the denominator of quality-adjusted life years. In other words, lost current and future earnings due to disease are not part of the cost-effectiveness analysis.

It is unlikely that many primary prevention strategies will "pay for themselves." In order to do this the savings in treatment costs would have to exceed the primary prevention expenditures. But even if they do not completely pay for themselves, they may be a much better value than the treatment costs because they may also be associated with a much higher quality of life and yield a higher return for the dollar. One strategy that seems to be a very good value is implementing smoking prevention and cessation programs, especially for young people and for persons who currently smoke. A study commissioned by the Texas Division of the American Cancer Society estimated that a four-year tobacco prevention program costing $200 million from Texas' tobacco settlement money recommended by the Texas Inter-Agency Tobacco Task Force was likely to save $440.5 to $972.7 million in long-term costs to the Texas Medicaid program.[27] These amounts were for adults only and did not take into account secondary benefits such as fewer low-birth weight babies and effects from second-hand smoke, so savings are likely to be even higher. Another study found that smoking cessation counseling costs $5,429 to $15,833 per year of life saved, a relatively cheap cost compared to many other interventions.[28]

In looking at and proposing primary prevention strategies it is important to look at the world over time with these strategies and without them. Although it might seem difficult to deny problematic tertiary treatment now for medical conditions in order to fund prevention strategies it will be far crueler to limit treatment more drastically in the future if those conditions become far more prevalent due to inadequate prevention initiatives.

Secondary Prevention/Early Detection

Guidelines and Strategies

Many different screening tests exist for the early detection of cancer in individuals who have a higher risk of a certain cancer or in whom cancer is suspected due to their symptoms. These are specific to different types of cancer and are administered on an individual as-needed basis, so they will not be discussed here except where they overlap with the screening recommended for the general population (for example, the same procedure, a mammogram, is called a diagnostic mammogram if given to a women in whom breast cancer is suspected, and a screening mammogram if given to an asymptomatic woman). The American Cancer Society has developed general guidelines for screening asymptomatic people for several of the most common cancers. Guidelines for four cancers are listed below; most other cancers do not have reliable and specific early detection methods, other than visual and manual detection for skin cancers or others on or near the surface of the body. Many cancers, such as lung, brain, ovarian, and pancreatic cancer, are usually detected only when the cancer is far enough along for the symptoms to become noticeable, which is usually in the advanced stages.

Table 2. ACS Guidelines for Cancer-Related Check-Ups for Asymptomatic Individuals

Test or Procedure	*Age*	*Frequency*
Breast Cancer (female)		
Breast self-exam	20 and over	every month
Clinical breast exam	20-39; 40 and over	every 3 years; every year
Mammography	40 and over	every year
Cervix Uteri (female)		
Pap test	sexually active or 18 and over	every year *(may be less frequent after 3 or more normal results)*
Pelvic exam	sexually active or 18 and over	every year
Colon and Rectum (male and female)		
One of the following five options: *(option 3 preferred by ACS; a DRE should be done with options 2-5)*	*(People at high risk may need to begin testing earlier)*	*(People at high risk may need to be screened more frequently)*
1. Fecal occult blood test (FOBT)	50 and over	every year
2. Flexible sigmoidoscopy	50 and over	every 5 years
3. FOBT every year plus flexible sigmoidoscopy	50 and over	every 5 years
4. Double contrast barium enema	50 and over	every 5 years
5. Colonoscopy	50 and over	every 10 years
Prostate (male)		
Digital rectal exam (DRE) and prostate specific antigen blood test (PSA)	50 and over *(men with high risk should begin testing at age 45)*	every year *(if life expectancy is at least 10 years; given with information about benefits and risks of testing and treatment so men can make informed decisions)*

Adapted from: American Cancer Society, *Cancer Facts & Figures 2001*, p. 35.

The five-year survival rate for these four cancers and the other three for which the American Cancer Society has early detection recommendations (testes, skin, and oral cavity) is 81 percent (excluding people who die of other causes). Cancer prognosis is greatly improved by early detection, and they estimate that if all Americans followed these recommended screening guidelines that the five-year survival rate for these cancers would increase to about 95 percent.[29] Some other organizations' recommendations differ somewhat from those of the American Cancer Society, as stated in the following sections on specific cancers and their screening methods.

Breast cancer is the most common cancer in women, though lung cancer has replaced it as the most deadly. Since 75 percent of breast cancer cases occur in women with no high-risk factors, all women should be screened for breast cancer. Mammography will not identify 10 to 15 percent of breast cancers even in the best circumstances, so this screening method should be combined with clinical exams and self-examination for the best outcome.[30] Screening is effective in breast cancer because it has recognizable preinvasive stages that are highly curable: ductal carcinoma in situ and lobular carcinoma in situ. Even patients with early stages of invasive cancers often survive for a long time after diagnosis, but women diagnosed with stage III or IV cancer usually have a poor prognosis. Even though mammograms are relatively expensive for a screening test and are not perfect (no tests are), they have been shown to be effective in reducing breast cancer mortality, and there is no argument among cancer organizations in recommending that women over 50 have them every 1 to 2 years.

There is some controversy, however, on how effective mammography is for women under age 50. Some studies show little or no effectiveness of mammograms in ages 40-49,[31] while others claim there is some benefit but it may not be cost-effective.[32] Although the American Cancer Society recommends annual mammograms after age 40, some other organizations recommend starting at age 50, including the American Academy of Family Physicians. The National Cancer Institute looked at a number of clinical trials spanning three decades and enrolling 500,000 women ages 40 to 69, and meta-analysis showed the following results: mammograms in women aged 50-69 reduced mortality by 30-35 percent, and in the 40-49 age group mortality was reduced by 17 percent overall, though some studies saw no difference (there is not enough evidence for recommendations over age 70). Recommendations from a National Institutes of Health Consensus Development Conference on Breast Cancer Screening in 1997 contained a majority report stating that there was not enough evidence to recommend universal screening of all women in their forties, and a minority report that believed the data did support screening in this age group (both sides agreed that if women in their forties wanted mammograms, their insurance should pay for them). The National Cancer Institute compromised by saying that women "in their forties or older" should get regular mammograms every one to two years, and should start earlier if they have increased risk and it is recommended by their doctors.[33]

A very new method developed by Dr. Susan Love for detecting the earliest stages of breast cancer and precancer (years before it is likely to show up on mammograms) is called ductal lavage. It involves inserting a very thin catheter into the milk ducts of the breast where cancer originates, washing them out with a saline solution, and then examining the cells that are washed out for abnormalities. It is reported to take about 15 minutes and be less painful than a mammogram, and it is hoped that eventually drugs could be introduced directly into the ducts to kill abnormal cells before they become malignant.[34]

Lung cancer is not the most commonly diagnosed cancer in Texas, but it is the most fatal, often due to it being detected later than other cancers, and thus at less treatable stages.[35] Developing effective early screening programs for lung cancer could save many lives, as recognizable symptoms usually do not appear until the disease has spread to other parts of the body. Currently, only about 15 percent of lung cancers are found in the early stages before it has metastasized, and many of these are found incidentally, during testing being performed for other medical conditions such as heart disease or pneumonia. If lung cancer is found and treated before it has spread to the lymph nodes, the five-year survival rate is 50 percent, but since most cancers are not found this early, the overall five-year survival rate for all lung cancers is only 14 percent.[36]

Chest x-rays and sputum cytology can be used to screen for lung cancer, but eight studies over the last 40 years have shown that these do not usually find lung cancers early enough to improve the patient's prognosis, so screening is not a routine practice even for those at higher risk.[37] There continues to be debate surrounding this issue, however, especially for those at high risk such as heavy smokers.[38] While this continues to be debated, there seems to be more agreement (in the U.S. at least) that current lung cancer screening methods should not be implemented in the general population at this time. About 30,000 subjects were enrolled in several of these early studies in the 1970s and 1980s, and even though the initial results were not promising, sputum samples were saved and reexamined later to compare cells from patients who later developed cancer to those who did not. These new studies have shown some biomarkers that are helpful in predicting later development of lung cancer, and research continues on these and other new methods for identifying early lung cancer cases.[39]

Prostate cancer is the most common cancer in men in the U.S., though it is not the most deadly. The incidence of prostate cancer is rising annually due to more early detection occurring, but there are controversies surrounding early detection and follow-up treatments. These stem from the fact that many, and possibly most, men over age 50 have some histologic evidence of this cancer, but clinically significant prostate cancer is much less prevalent.[40] Therefore, clinically insignificant prostate cancer is often detected and can lead to unnecessary treatment. Patients with advanced prostate cancer have a poor prognosis, but it is not clear that aggressive management of small non-aggressive cancers affects survival, though it does impair quality of life. Only one-tenth of the men believed to have prostate cancer actually die from it (thus the reason it is said that more men die with prostate cancer than from it).[41]

As far as screening methods for prostate cancer, digital rectal examination (DRE) is quick, safe, and inexpensive when done with an annual physical exam, but it has a rather low sensitivity and specificity, so it is recommended that it be combined with the prostate-specific antigen test (PSA). This test has a high positive predictive value, but the problem remains that there is not enough information currently to distinguish between indolent cancers that would be best managed by observation or "watchful waiting" and more aggressive cancers that need early intervention. The PSA test has not demonstrated that it results in reduced mortality, but it is still used by many physicians as an integral part of preventive care for men.[42] Though the American Cancer Society recommends screening for all men over age 50 (with the new caveat that they must agree to it and make an informed decision by being given information on benefits and risks of testing and treatment), the National Cancer Institute, the U.S. Preventive Services Task Force, and the American Academy of Family Physicians all believe that no general recommendation for screening should be made, and that the choice of whether average-risk men should get regular PSA tests should be left up to the individual men and their doctors.[43]

Over 90 percent of *colorectal cancers* start out as benign adenomatous polyps that progress to carcinoma. The adenoma stage is highly curable with surgery to remove the polyps, but once carcinomas infiltrate and metastasize, prognosis is poor. If screening is regularly performed and adenomas are identified in time and removed, and if these people keep receiving colonoscopies or other screening periodically, in theory almost all cases of colorectal cancers could be prevented.[44] The fecal occult blood test is not a very conclusive or accurate cancer screen in itself, because many non-cancerous conditions such as diverticulitis and peptic ulcers can also cause blood to appear in the feces, and adenomas and carcinomas may not always bleed, but it is simple and non-invasive and is useful in detecting large lesions and to select people for further testing. Flexible sigmoidoscopy permits direct visualization of the closer part of the colon and can detect about half of all colorectal cancers (virtually all of those in the first 60 centimeters of the colon). Studies have shown that periodic sigmoidoscopic screening can reduce overall colorectal cancer mortality by about one-third (a 70 to 80 percent reduction in the half that are detected). Colonoscopy is a more expensive and invasive procedure, but it allows all of the colon to be examined in most patients. However, the risk for perforation of the colon is 1 in 1,000 procedures, and about 1 to 3 of 10,000 patients receiving colonoscopies die of complications.[45] Some people have suggested that it only be done once, between ages 50-60, and others contend that a high-quality, double-contrast barium enema exam is a safer, less time-consuming, and less expensive alternative. Small lesions are difficult to identify with the barium enema, however, and not all radiologists are skilled in this area.[46]

A very recent breakthrough just tested at the Mayo Clinic may eventually replace the more expensive and invasive procedures for detecting colon cancers. The new method, which involves DNA testing of discarded cells in stool samples, was reported to have very high accuracy rates and no false positives in an initial trial; a large-scale clinical trial of this method, sponsored by the National Cancer Institute, will begin in January 2001.[47] Up to 5 percent of colorectal cancers are caused by hereditary colorectal cancer syndromes, and it is especially important for these people to receive regular screenings; however, only about half of the general population who is eligible for screening actually gets screened, so more education is needed of both physicians and consumers. New methods that are cheaper and noninvasive, like this DNA detection and a new method undergoing testing called a virtual colonoscopy (combining imaging like a CT scan with a virtual reality computer program to give realistic 3-D images of the colon),[48] are expected to increase screening compliance.

There are some *other cancers* where early detection has been shown to be efficacious. Cervical cancer deaths have decreased dramatically since the Pap (Papanicolaou) test was developed in the 1930s and became routine in the 1960s; it is estimated that 70 percent of cervical cancer deaths have been prevented in the United States (this cancer is still a major killer in developing countries). This test detects precancerous changes in cells (called CIN, or cervical intraepithelial neoplasia) and allows for early localized treatment of the areas before they become invasive. Skin cancer incidence has risen dramatically since the 1950s, and most of the skin cancer deaths in the U.S. are due to melanoma. Visual screening and palpation methods are quick, painless, and inexpensive, and most small cutaneous melanomas as well as premelanomas can be cured by surgical removal. The benefits and costs are still being investigated, and examinations are recommended every three years from ages 20 to 40 and every year after age 40, along with self-examination and a reporting of any suspicious changes in the skin. More research is needed on effective screening strategies for many other cancers, and thus screening of asymptomatic people is not currently recommended; these include ovarian, endometrial, pancreatic, stomach, liver, and esophageal cancers.

Important Issues with Screening

The goal of screening is the early detection and treatment of a cancer, with a corresponding reduction in the mortality rate. There are two requirements for an effective cancer screening program: one is that the screening test must detect cancer in an early stage, and the other is that the treatment resulting from this detection must be more effective than treatment given at a later time when cancer is usually diagnosed.[49] Screening for some cancers meet both of these criteria (for example, breast and cervical), but others meet only one or neither (for example, lung and prostate). There are both advantages and disadvantages to cancer screening, even if effective. Advantages include an improved outcome for some patients, including those who would have died without the early detection of their disease; less radical treatment, and thus fewer resources and costs that might be used in some cases of cancer; and reassurance for those with negative test results. Disadvantages include a longer period of morbidity for patients whose outcome does not change, overtreatment of borderline abnormalities (causing higher direct and indirect costs), false reassurance for those with false-negative results (who may tend to dismiss subsequent symptoms, delaying treatment), unnecessary morbidity for those with false-positive results, and side effects of the tests themselves.[50] All of these factors must be evaluated before instituting screening policies.

Screening programs for the general population should be considered only if the following conditions are met: the disease in question is a serious problem in the population; an effective treatment is available; the screening procedure is safe, rapid, inexpensive, and relatively easy; the test can be monitored and reproduced; and the test performance is acceptable. Performance can be measured by three standards: sensitivity, specificity, and positive predictive value. *Sensitivity* is the proportion of people with the disease who test positive, *specificity* is the proportion of people who do not have the disease who test negative, and the *predictive value of a positive test* (PVP) is the proportion of those testing positive who actually have the disease, which is a function of sensitivity (Se), specificity (Sp), and disease prevalence (P). The mathematical relationship between these measures is PVP = PSe/[PSe + (1-P)(1-Sp)].[51] For screening, high specificity is more important than high sensitivity, while in using the same test for monitoring after treatment, high sensitivity is more important than high specificity. However high or low they may be, the screening test properties should be tested and known in advance.

Even if screening properties are very high, this does not indicate anything about what effect the screening will have on the consequences of the particular cancer in question. For example, a nonprogressive preclinical disease state (as is often seen in prostate cancer) is more likely to be detected by routine screening but is not likely to cause death, so identification and treatment may be more harmful than not getting treatment. Once a screening test is implemented, it can be included into a program of treatment and follow-up, which must then be evaluated in terms of its effect on cancer mortality.[52] There are several types of biases that can complicate evaluation of screening programs: *Lead-time bias* refers to the amount of time that screening advances the diagnosis of the disease, so that it may appear that people who were diagnosed through screening lived longer than those diagnosed later, even if they would have died at the same time. *Length-biased sampling* refers to the fact that a single screening is more likely to detect slow-growing, non-aggressive cancers because of their higher prevalence in the population, so these people will also appear to live longer, though this may be due more to their type of cancer than the fact that it was detected early (this bias can be minimized through repeated screenings over time). *Overdiagnosis bias* refers to an increase in length-biased sampling so that the screening test threshold is lowered and non-aggressive tumors that may never cause a problem are identified.[53]

There are still many obstacles to screening becoming a major contributor to cancer control, including the unfavorable natural progression of many cancers, poor compliance of those most at risk, economic barriers, and problems with the tests themselves (such as costs and morbidity resulting from false positives, false negatives, and side effects). Three of the screenings most likely to make an impact on cancer mortality are those for breast, cervical, and colorectal cancers, but there are many more that are inconclusive. Since screening has the potential to offer a more rapid return than primary prevention, however (since this may take decades more to be fully understood), secondary prevention and continued research on it should remain a priority.[54]

Cost-Effectiveness of Screening

There are several different ways to do comparative health economic analyses. One of these, cost-effectiveness analysis, is the ratio of health benefit to cost of the intervention, with benefit measured in terms of clinical outcomes (such as illness prevented or deaths averted), not cost.[55] This approach generally assumes that society has limited resources and that other programs are under consideration, and they are ideally analyzed after a randomized trial has demonstrated a reduction in mortality from a screening method. Calculating cost-effectiveness for cancer screening is complicated, and cost-effectiveness should not be the only deciding factor for funding; ethical and political issues must also be considered.

Cost-effectiveness analysis attempts to estimate the net cost of the policy or intervention per additional quality-adjusted life year added. (When quality-of-life information is not available, cost-effectiveness is sometimes calculated and reported in "life years saved" instead of "quality-adjusted life years saved.") This analysis is basically a ratio of the difference in costs to the difference in effectiveness between two interventions, or an intervention and no intervention. The equation that summarizes the calculations is the following:[56]

$$C/E \quad = \quad \frac{\Delta C + \Delta C_{SE} - \Delta C_{morb} + \Delta C_{LE}}{\Delta Y - \Delta Y_{SE} + \Delta Y_{morb}}$$

The variables in this equation are defined as follows:

C/E = The cost per quality-adjusted life year of the proposed intervention as compared to the status quo.
ΔC = The present value of the cost of the proposed intervention.
ΔC_{SE} = The present value of the cost of treating side effects of the intervention.
ΔC_{morb} = The present value of the costs saved from not treating conditions that were prevented or ameliorated.
ΔC_{LE} = The present value of the additional costs to the medical care system of caring for conditions that would not have occurred if the person had not lived longer.
ΔY = The present value of the change in life years due to the intervention.
ΔY_{SE} = The adjustment for changes in quality of life due to the side effects of treatment.
ΔY_{morb} = The adjustment for changes in quality of life due to the reduction or prevention of disease.

The value of conducting cost-effectiveness analysis systematically is that it permits the analyst to compare a number of different initiatives. Generally the analysis should be done from the perspective of society as a whole. The following table summarizes the different components of cost-effectiveness analyses and offers a definition of each and other comments.

Table 3. Factors in Cost-Effectiveness Analyses

Variable	Definition	Measurement	Issues
Reference case or status quo.	The base from which the net costs and benefits of a change in services or policy are measured.	May be current treatment protocol or payment policy.	Not always easy to characterize.
Proposed initiative or policy and the population affected	Clearly specify the nature of the proposal and which persons will be affected or eligible over time. Need to define clearly.	Need to specify the deviation from the status quo or reference case.	Must also include others who may be affected indirectly (e.g., elderly may be negatively affected by nutritional additives to cereals to benefit youths).

Variable	Definition	Measurement	Issues
Cost of the initiative or policy	The net cost of the change being analyzed.	Add all the additional costs relative to the status quo. Include all incremental costs of screening, prevention, and treatment, and net costs of caring for the illness discounted to the present.	Whether to include cost of caring for other conditions in persons who live longer than they could have expected due to the intervention. Need to estimate future costs that may depend on compliance. May not be able to accurately measure future costs because of 1) cost saving breakthroughs or 2) cost enhancing extended morbidity.
Effectiveness of the initiative or policy	Increase or decrease in quality adjusted life years.	Present value of expected change in quality adjusted life years. Need method of estimating quality adjusted.	Difficult to know relative impact of the initiative, need to make assumptions about compliance, efficacy of alternatives, and risks to life from other causes if life is extended.
Discounting percentages	The rate at which future costs and quality adjusted life years should be discounted to the present.	Usually value future costs in today's dollars so only discounting at 2-3% for the time value of money.	Need to discount future quality adjusted life years since they are evaluated relative to discounted dollars.
Sensitivity analysis	The extent to which the results of the analysis depend on the assumptions.	Vary different parameters and see what different results are generated.	Need to see if results are dependent on cost estimates, compliance estimates, efficacy estimates, and discounting values.

The cost-effectiveness estimates given below for various cancers use different methods, discounting rates, and dollar-years, and are provided for rough comparison only. The decision about what the boundary is between a cost-effective intervention and one that is not cost-effective is mainly political, reflecting the value of health to the particular society, as well as its affluence. This threshold is not usually explicitly stated, but it can be somewhat divined by analyzing the health coverage decisions of governmental and private payers. In the U.S., well-established procedures like mammograms and dialysis generally have cost-effectiveness ratios of $50,000 or less per LY saved, while those costing more than $100,000/LY are usually considered cost-ineffective (too expensive for the amount of benefit gained) and are not covered by insurance. The cost-effectiveness of procedures with ratios between $50,000 and $100,000 is not as clear-cut and can depend on the situation, and coverage varies.[57] As tertiary and chronic interventions become more expensive, the calculus of cost-effectiveness will seem to show that prevention is now more cost-effective. It must be remembered that this is ironically an artifact of the decision to pay for the most expensive interventions.

There are a variety of estimates for cost-effectiveness of secondary prevention. One study shows the cost-effectiveness of colorectal screening to be about $40,000 per life-year saved,[58] while another estimated $28,848-113,348 per LY saved (the screening methods were not given).[59] In people aged 65, a study showed an annual fecal occult blood test (FOBT) to cost about $35,000 per life-year gained.[60] Another study calculated the cost-effectiveness of a variety of screening techniques for colorectal cancer in white men with 60 percent compliance. They found that FOBT plus a sigmoidoscopy every five years (with follow-up colonoscopy if any suspicious polyps were seen) costs about $51,200 per LY gained, while the same screening every 10 years costs $21,200 per LY. The sigmoidoscopy alone every 10 years (with follow-up colonoscopy for all polyps) costs about $16,100 per LY saved.[61]

Annual mammography was found by one study to cost about $34,500 per life-year saved.[62] Another study estimated that screening mammography costs about $20,000 to $50,000 per life-year saved,[63] while another found that a combination of annual mammograms and clinical breast exams (followed by treatment as needed) prevents premature death at a cost of $22,000-$84,000 per life-year gained in women age 55-65.[64] Cervical cancer screening (presumably pap smears) were found by one study to cost $33,572 per life year saved.[65] Another study showed a cost of $40,000 per LY gained for annual cervical cancer screening, and a cost of $14,000 per LY for screening every three years (age 20-75) for average risk women. Screening every three years is almost as effective as screening annually (reduction of invasive cervical cancer by 91.2 percent vs. 93.3 percent).[66]

A study on prostate cancer calculated cost-effectiveness ratios for prostate cancer screening that vary by age and cure rate of prostate cancer. For men aged 50-59, the cost per quality-adjusted life-year gained was $16,029 (assuming 100 percent cure rate) and $24,868 (assuming 75 percent cure rate). For ages 60-69, the cost per quality-adjusted life-year gained was $27,507 and $46,976 for 100 percent and 75 percent cure rates, respectively. For ages 70-79, the cost per QALY was found to be $162,095 (100 percent cured) and $612,095 (75 percent cured).[67] Another study calculated cost per life-year saved by prostate screening (PSA and DRE) and treatment. Its cost ranges per LY (not quality-adjusted) are again given per age group: $2,339-$3,005 for ages 50-59 and $3,905-$5,070 for ages 60-69.[68] The figures are much higher in the quality-adjusted costs because men often live for a long time after prostate cancer detection and treatment (whether or not cured), therefore complications and related quality-of-life issues (such as impotence and incontinence) are multiplied by many years.[69]

Discussion of Primary and Secondary Prevention and Cost-Effectiveness

The main goal of prevention is not to save money but to spare people from avoidable misery and premature death. Primary and secondary prevention may indeed be cost-effective for some cancers, but this should be put into perspective when overall healthcare costs are being discussed. Part of the big picture that needs to be considered is that reducing or eliminating significant fatal diseases like cancer, heart disease, and strokes will make the population live longer, and at older ages is when disabling conditions such as osteoporosis and related fractures, dementia, and loss of vision and hearing become more common and healthcare costs are greatly increased. In nations with low mortality, prevention of fatal diseases without prevention of nonfatal, disabling conditions will increase healthcare costs in the long run.[70]

Though the cost-effectiveness, desirability, and safety of screening for some cancers is not always clear for the general population, it is usually much clearer for that segment of the population at high risk for certain cancers. For example, women with a hereditary mutation of the BRCA1 gene (about 1 in 600 women) have much higher percentages of developing breast cancer: 16 percent by age 40, 42 percent by age 45, 59 percent by age 50, 72 percent by age 55, and 80 percent by age 65. People with this mutation are more likely to get bilateral breast cancer and at a younger age, and it also raises the risk of colon cancer in both sexes by about 10 percent. Of 70-year-olds with this gene, 85 percent have had breast cancer, and 40-60 percent have ovarian cancer.[71] Though this paper is not focusing on those with high risk, clearly in cases such as these, earlier and more frequent cancer screenings are warranted, and sometimes more aggressive prevention that is not recommended for the general population, such as the drugs tamoxifen or raloxifene for breast cancer prevention (tamoxifen has been shown to reduce breast cancer occurrence in high-risk women, but with a potential for serious side effects, so a large clinical trial is underway comparing it to raloxifene, another SERM drug currently used for osteoporosis).

The problem in hereditary cancers is that there are not yet simple, inexpensive tests for determining who carries these mutations, and even if there were, there is often no current direct treatment, and there are other issues to consider. The most common ways of determining genetic risk are through examining family medical histories and from the patient herself, such as if a woman is diagnosed with breast cancer at a young age. DNA analysis and gene sequencing is now available, but it is time-consuming and expensive. There are abbreviated tests that are cheaper and only examine parts of genes but still cost several hundred dollars. These tests are only given to people with a family medical history suggesting certain inherited cancers, and only if they agree to it after weighing the pros and cons. Genetic testing is not routine because while the benefit is that it could identify certain inherited mutations and thus increased risk and the chance for more diligent screening efforts, whether the results are conclusive or inconclusive the current disadvantages and ethical issues remain: increased anxiety, impact on future child-bearing, and possible discrimination in obtaining health insurance, life insurance, and employment. This is currently legal in most states, and can happen even if it is discovered only that someone underwent genetic testing, regardless of the results.

The state's cancer plans provide comprehensive goals and objectives for promoting awareness and education about cancer, increasing prevention and screening efforts, and improving treatment and access to services. The Texas Cancer Plan is a plan for cancer in general, and plans also exist for specific cancers such as colorectal, lung, and skin, as well as prevention of spit tobacco use. Besides goals relating to the disease and increasing education efforts, data and research needs are also addressed in the cancer plans.

The cancer data collection system described in Goal IV, Cancer Data and Planning, of the Texas Cancer Plan[72] would be very useful if and when it becomes fully operational. The lack of consistent and specific data on many aspects of cancer control, especially cost data, in Texas and even nationwide, became very apparent during the course of this study. Having the various cancer-related entities cooperating and utilizing a centralized data collection system that would be available to researchers and others would help the individual organizations' efforts as well as help policymakers to make decisions using more accurate and up-to-date information. If the strategies outlined in these plans are followed and supported with sufficient funding, the lives of many Texans will be improved. It cannot be guaranteed that these initiatives would save the state money. However, with well-designed primary and secondary prevention initiatives, the economic and social costs of cancer morbidity and premature mortality would be reduced.

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COMPREHENSIVE CANCER CONTROL PROGRAM

http://www.tdh.state.tx.us/tcccp

The Cost of Cancer in Texas

A Report to the
Texas Comprehensive Cancer Control Coalition
on the Economic Impact of Cancer

by
The Lyndon B. Johnson School of Public Affairs,
The University of Texas at Austin
and the
Texas Health Care Information Council

- **Executive Summary**

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- **Direct and Indirect Costs, 1998**

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- **Hospital Inpatient Costs of Cancer in Texas**

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– 2nd edition –

Hospital Inpatient Costs of Cancer in Texas

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Hospital Inpatient Costs of Cancer in Texas

Abstract

This study examines hospital inpatient costs of cancer in Texas with special attention to colorectal, lung, breast, and prostate cancer. The research is based on data collected from Texas civilian hospitals about discharges of Texas residents during the period of January to March 1999. Costs for most hospitals were based on DRGs for the respective hospitals stays. The Texas Medicaid Adjusted Standard Dollar Amount for each hospital was multiplied by the Medicaid payment weight for each of the respective DRGs. For seven children's hospitals, charge information was adjusted by the Medicaid cost-to-charge ratios for the respective facilities.

The hospital inpatient cost of treating Texas residents with cancer among the discharge diagnoses was about $1.85 billion in 1998, representing 12.3 percent of all hospital costs for all diseases. The cost of caring for patients with cancer as principal diagnosis was about $1.05 billion. About 31 percent of hospital costs associated with cancer were for treating persons with colorectal, lung, breast, or prostate cancer. Details are provided in the report by demographic groups, by insurance coverage, and by Texas public health region.

Introduction

Cancer in the U.S. is thought to have accounted for 13.6 million days of hospitalization in 1993 at a cost of $24.1 billion, and hospitalization accounted for almost two-thirds of the U.S. direct medical costs of cancer.[1] Costs of hospitalization for cancer in Texas have not been clear. Williams and Begley produced estimates of Texas cancer hospitalization costs for 1988 (about $700 million). However, they relied heavily on national data and recommended that, in the future, data more specific to Texas should be collected.[2]

Beginning in 1999, the Texas Health Care Information Council (THCIC) began collecting discharge data from most Texas hospitals, and the resulting database offers new opportunities for constructing estimates of the costs of hospitalizations associated with cancer. This report is based on that data, and its primary purpose is to estimate the hospital costs of cancer among Texas residents with special attention to colorectal, lung, breast and prostate cancer. This report also provides data on the demography of patients hospitalized with cancer and details on their health insurance coverage.

Methods

The data available for this study covered 610,000 discharges from 411 Texas hospitals from January through March 1999. Most Texas hospitals, including rehabilitation hospitals, participated. Certain facilities, including some small community facilities, military hospitals, and VA hospitals, did not participate. The non-participating community hospitals accounted for only 6 percent of the non-federal hospital beds in Texas. Thus, the data are believed to be reasonably inclusive with respect to civilian hospitals.

Within the database were 590,000 discharges of Texas residents as determined by zip code information. Of those patients, 50,349 discharges at 363 facilities had a diagnosis of cancer (ICDs 140-239), either as principal diagnosis or among eight secondary diagnoses. The reader should note that this definition of cancer includes both malignant and benign conditions, with the rationale that when benign tumors are associated with hospitalization, there is substantial likelihood that the hospitalization was for the purpose of treating pre-cancerous conditions, thus preventing emergence of malignant conditions.

The records for patients with cancer were assigned to colorectal cancer (ICDs 153-4), lung cancer (ICD 162), breast cancer (ICD 174), prostate cancer (ICD 185), or other types of cancer. When more than one category of cancer was present among the discharge diagnoses, priority was given to the type of cancer listed earliest among the nine possible diagnostic codes.

The database did not contain cost information. For most facilities, costs were estimated by multiplying the Medicaid Adjusted Standard Dollar Amount (ASDA) for each hospital by the Texas Medicaid DRG weight for FY 1998, depending on the DRG associated with each of the hospital stays. The Medicaid ASDAs were developed from analyses of costs of treating average patients at the respective hospitals. The DRG weights account for the complexity of the conditions of the various patients. A handful of hospitals were not Medicaid contractors and, for those, the Medicaid DRG weights were applied to the Standard Dollar Amounts (SDAs) for the respective facilities without considering the percentage discount factor which the Medicaid program negotiates with individual hospitals. Fifty-four cancer-related stays in the database had DRGs with a payment weight of zero. Costs for those stays were estimated on the basis of the average cost among stays for persons having the same type of cancer (lung, breast, prostate, colorectal, other). For cancer stays at seven children's hospitals, charge information was adjusted by each hospital's Medicaid cost-to-charge ratio for fiscal year 1998, including discount factors, to obtain an estimate of cancer costs.

Because information was available for only one calendar quarter (first quarter 1999), all figures in this report are annualized and reported for fiscal year (FY) 1998. While it is possible that the calendar quarter studied was unusual in some way, it seems unlikely that cancer admissions would follow any seasonal pattern.

Findings

On an annual basis, Texas residents produced about 2.36 million hospital stays at a total cost of $15.0 billion (see Table 1). Of those hospitalizations, about 201,000 (8.5 percent) had cancer listed among the discharge diagnoses, and about 100,000 (4.2 percent of total) listed cancer as the principal diagnosis. The estimated cost of treating Texas residents with cancer was about $1.85 billion, including $1.05 billion for patients having cancer as the principal diagnosis. Another $176 million was associated 13,000 hospital stays for treatment of non-residents with cancer among the discharge diagnoses.

The average length of stay was longer for cancer patients (6.5 days) when compared to patients without cancer (5.3 days). And average cost per hospitalization for those with cancer ($9,199) was higher than for those without cancer ($6,092). Average cost per hospitalization for those with cancer as principal diagnosis was $10,490.

Table 1. Cancer-Related Hospitalizations and Estimated Costs among Texas Residents, FY 1998

	Number of Stays	Hospital Days	Average Days/Stay	Estimated Cost (x $1,000)	Average Cost/Stay
Cancer among Diagnoses	201,396	1,308,272	6.5	$1,852,574	$9,199
Cancer as Principal Diagnosis	100,112	645,224	6.5	$1,050,191	$10,490
Cancer as Secondary Diagnosis	101,284	663,048	6.5	$802,383	$7,922
Cancer Not Present	2,159,412	11,439,289	5.3	$13,155,014	$6,092
All Hospital Stays	2,360,808	12,747,561	5.4	$15,007,588	$6,357

Notes: *Cancer defined as ICDs 140-239.*
Estimates annualized from discharges during January-March 1999.
Data do not include some small community hospitals having about 6 percent of hospital beds in Texas.

Findings for specific types of cancer varied (see Table 2). Cases with lung cancer among the discharge diagnoses were the most expensive ($228 million), followed by colorectal cancer ($161 million), prostate cancer ($98 million), and breast cancer ($91 million). These four types of cancer accounted for about 31 percent of the costs among those hospitalized with cancer. Hospital stays for those with colorectal and lung cancer tended to be longer than for those with other types of cancer. Stays for those with breast or prostate cancer tended to be shorter. Average cost per stay followed the same pattern, with higher averages for colorectal and lung cancers, and lower averages for breast and prostate cancers.

Table 2. Cancer-Related Hospitalizations and Estimated Costs among Texas Residents by Type of Cancer, FY 1998

	Principal or Secondary Diagnosis	Principal Diagnosis	Secondary Diagnosis
Any Cancer (ICD 140-239)			
Number of Stays	201,396	100,112	101,284
Patient Days	1,308,272	645,224	663,048
Average Length of Stay	6.50	6.45	6.55
Estimated Cost	$1,852,574,000	$1,050,191,000	$802,383,000
Average Cost Per Stay	$9,199	$10,490	$7,922
Colorectal Cancer (ICD 153-4)			
Number of Stays	13,292	8,928	4,364
Patient Days	122,808	85,272	37,536
Average Length of Stay	9.24	9.55	8.60
Estimated Cost	$161,428,000	$122,035,000	$39,393,000
Average Cost Per Stay	$12,145	$13,669	$9,027
Lung Cancer (ICD 162)			
Number of Stays	21,976	11,040	10,936
Patient Days	171,336	92,424	78,912
Average Length of Stay	7.80	8.37	7.22
Estimated Cost	$228,048,000	$136,044,000	$92,004,000
Average Cost Per Stay	$10,377	$12,323	$8,413
Breast Cancer (ICD 174)			
Number of Stays	11,084	6,900	4,184
Patient Days	53,488	27,692	25,796
Average Length of Stay	4.83	4.01	6.17
Estimated Cost	$91,273,000	$58,626,000	$32,647,000
Average Cost Per Stay	$8,235	$8,497	$7,803
Prostate Cancer (ICD 185)			
Number of Stays	13,192	6,708	6,484
Patient Days	73,504	30,648	42,856
Average Length of Stay	5.57	4.57	6.61
Estimated Cost	$98,157,000	$46,266,000	$51,891,000
Average Cost Per Stay	$7,441	$6,897	$8,003
All Other Cancers			
Number of Stays	141,852	66,536	75,316
Patient Days	887,136	409,188	477,948
Average Length of Stay	6.25	6.15	6.35
Estimated Cost	$1,273,668,000	$687,220,000	$586,448,000
Average Cost Per Stay	$8,979	$10,329	$7,786

Note: To avoid double-counting, when a hospital record contained more than one cancer diagnosis, the record was assigned to type of cancer according to the ordering of the diagnoses.

The age distribution of cancer patients differed according to the type of cancer (see Table 3). With the patient population stratified into 15-year age groups, the modal (most frequent) group among patients with any kind of cancer was age 60-74. However, for breast cancer, there were more patients in the age 45-59 range, and, for prostate cancer, the modal group was age 75 years and over.

Almost 59 percent of persons hospitalized with cancer were female, partly as a reflection of the nature of the elderly surviving population. Hospitalizations for colorectal cancer were about evenly divided between the sexes. A substantial majority of lung cancer patients were male. Almost 64 percent of the patients with "other" types of cancer were female.

The proportionate distribution of hospitalizations for cancer differed by ethnicity and type of cancer. For the four specific types of cancer, patients were more likely to be non-Hispanic White and Other than for the "other" types of cancer. This observation is particularly notable for lung cancer hospitalizations. Conversely, African American and Hispanic patients were less common for the four types of cancer of interest, and more common among the "other" cancer category. More precise analysis of demographic issues would consider population denominators and age distributions of the respective populations (see Appendix A for appropriate numerator details).

The demographic distribution of costs presents a similar pattern, except that costs for "other" types of cancer as not as highly concentrated among the female population (see Table 4). Details are available in Appendix B.

The primary payer for the respective cancer hospitalizations tended to differ according to type of cancer (see Table 5). For costs associated with hospitalizations of persons with any kind of cancer, 45.5 percent were covered by Medicare as primary payer, and about 40 percent were covered by private insurance. However, Medicare was primary payer for 60.5 percent of hospitalization costs for persons with colorectal cancer, and 70 percent of costs for persons with prostate cancer. For only 32 percent of costs associated with hospitalizations of persons with breast cancer was Medicare the primary payer, and these patients were more likely to rely on private insurance. No doubt these findings reflect the age distribution of the respective types of patients.

Among Texas hospitals, M.D. Anderson had the most discharges of Texas residents with cancer—about 8,612 with an estimated cost of $142 million (see Table 6). The next three hospitals with the most resident cancer patients were in Dallas (Baylor), Houston (Methodist), and San Antonio (Southwest Texas), which together had about 14,700 discharges of Texas residents with cancer with a total cost of $176 million. Of the 383 facilities in the database, half of the resident cancer-related discharges were from the 41 facilities serving the most cancer patients, and these accounted for 55 percent of the total cost.

Table 3. Age, Gender, and Ethnicity of Texas Resident Hospital Patients with Cancer, FY 1998

	Any Cancer ICD 140-239		Colorectal Cancer ICD 153-4		Lung Cancer ICD 162	
	number	*percent*	*number*	*percent*	*number*	*percent*
Age						
0-14	6,432	3.2%	12	0.1%	12	0.1%
15-29	7,596	3.8%	92	0.7%	56	0.3%
30-44	31,000	15.4%	620	4.7%	608	2.8%
45-59	45,016	22.4%	2,668	20.1%	4,180	19.0%
60-74	62,568	31.1%	5,104	38.4%	11,096	50.5%
75+	48,760	24.2%	4,796	36.1%	6,024	27.4%
Total	**201,372**	**100.0%**	**13,292**	**100.0%**	**21,976**	**100.0%**
Gender						
Male	83,568	41.5%	6,460	48.6%	12,412	56.5%
Female	117,804	58.5%	6,832	51.4%	9,564	43.5%
Total	**201,372**	**100.0%**	**13,292**	**100.0%**	**21,976**	**100.0%**
Ethnicity						
White/Other	142,068	70.6%	9,812	73.8%	17,296	78.7%
Black	25,560	12.7%	1,616	12.2%	2,392	10.9%
Hispanic	33,744	16.8%	1,864	14.0%	2,280	10.4%
Total	**201,372**	**100.0%**	**13,292**	**100.0%**	**21,976**	**100.0%**

	Breast Cancer ICD 174		Prostate Cancer ICD 185		Other Cancers	
	number	*percent*	*number*	*percent*	*number*	*percent*
Age						
0-14	0	0.0%	16	0.1%	6,392	4.5%
15-29	68	0.6%	8	0.1%	7,372	5.2%
30-44	1,672	15.1%	40	0.3%	28,060	19.8%
45-59	3,532	31.9%	1,668	12.6%	32,968	23.2%
60-74	3,428	30.9%	5,632	42.7%	37,320	26.3%
75+	2,384	21.5%	5,828	44.2%	29,740	21.0%
Total	**11,084**	**100.0%**	**13,192**	**100.0%**	**141,852**	**100.0%**
Gender						
Male	0	0.0%	13,192	100.0%	51,516	36.3%
Female	11,084	100.0%	0	0.0%	90,336	63.7%
Total	**11,084**	**100.0%**	**13,192**	**100.0%**	**141,852**	**100.0%**
Ethnicity						
White/Other	8,120	73.3%	9,904	75.1%	96,936	68.3%
Black	1,240	11.2%	1,672	12.7%	18,640	13.1%
Hispanic	1,724	15.6%	1,616	12.2%	26,260	18.5%
Total	**11,084**	**100.0%**	**13,192**	**100.0%**	**141,852**	**100.0%**

Note: Demographic information was missing for a few individuals.

Table 4. Estimated Inpatient Hospital Costs of Cancer Patients by Age, Gender, and Ethnicity, FY 1998

	Any Cancer ICD 140-239		Colorectal Cancer ICD 153-4		Lung Cancer ICD 162	
	cost (x $1,000)	*percent*	*cost (x $1,000)*	*percent*	*cost (x $1,000)*	*percent*
Age						
0-14	63,067	3.4%	126	0.1%	126	0.1%
15-29	70,525	3.8%	979	0.6%	1,081	0.5%
30-44	239,821	12.9%	7,120	4.4%	7,188	3.2%
45-59	416,351	22.5%	30,763	19.1%	44,201	19.4%
60-74	612,876	33.1%	62,832	38.9%	115,814	50.8%
75+	449,935	24.3%	59,610	36.9%	59,639	26.2%
Total	**1,852,575**	**100.0%**	**161,430**	**100.0%**	**228,049**	**100.0%**
Gender						
Male	859,019	46.4%	78,710	48.8%	128,794	56.5%
Female	993,556	53.6%	82,720	51.2%	99,255	43.5%
Total	**1,852,575**	**100.0%**	**161,430**	**100.0%**	**228,049**	**100.0%**
Ethnicity						
White/Other	1,342,196	72.5%	121,572	75.3%	181,029	79.4%
Black	218,832	11.8%	19,621	12.2%	24,716	10.8%
Hispanic	291,547	15.7%	20,235	12.5%	22,304	9.8%
Total	**1,852,575**	**100.0%**	**161,430**	**100.0%**	**228,049**	**100.0%**

	Breast Cancer ICD 174		Prostate Cancer ICD 185		Other Cancer	
	cost (x $1,000)	*percent*	*cost (x $1,000)*	*percent*	*cost (x $1,000)*	*percent*
Age						
0-14	0	0.0%	84	0.1%	62,732	4.9%
15-29	1,331	1.5%	43	0.0%	67,089	5.3%
30-44	20,040	22.0%	230	0.2%	205,244	16.1%
45-59	31,334	34.3%	11,185	11.4%	298,870	23.5%
60-74	22,403	24.5%	40,865	41.6%	370,964	29.1%
75+	16,165	17.7%	45,750	46.6%	268,771	21.1%
Total	**91,273**	**100.0%**	**98,157**	**100.0%**	**1,273,670**	**100.0%**
Gender						
Male	0	0.0%	98,157	100.0%	553,362	43.4%
Female	91,273	100.0%	0	0.0%	720,308	56.6%
Total	**91,273**	**100.0%**	**98,157**	**100.0%**	**1,273,670**	**100.0%**
Ethnicity						
White/Other	67,981	74.5%	73,391	74.8%	898,223	70.5%
Black	9,989	10.9%	13,314	13.6%	151,192	11.9%
Hispanic	13,303	14.6%	11,450	11.7%	224,255	17.6%
Total	**91,273**	**100.0%**	**98,157**	**100.0%**	**1,273,670**	**100.0%**

Note: Demographic information was missing for a few individuals.

Table 5. Estimated Inpatient Hospital Costs of Cancer Patients by Age and Primary Payer, FY 1998

	Private Insurance (x $1,000)	*Medicare (x $1,000)*	*Medicaid (x $1,000)*	*Self-Pay (x $1,000)*	*All Others (x $1,000)*	*Total (x $1,000)*
Any Cancer (ICD 140-239)						
Age 0-14	$27,125	$139	$29,964	$3,082	$2,756	$63,066
Age15-29	$38,382	$1,820	$17,801	$4,897	$7,622	$70,522
Age 30-44	$171,892	$12,210	$24,062	$14,535	$17,123	$239,822
Age 45-59	$297,222	$34,419	$30,911	$27,023	$26,777	$416,352
Age 60-74	$162,575	$396,766	$13,839	$15,176	$24,520	$612,876
Age 75+	$38,266	$398,389	$1,860	$2,699	$8,719	$449,933
Total	**$735,462**	**$843,743**	**$118,437**	**$67,412**	**$87,517**	**$1,852,571**
Percent	**39.7%**	**45.5%**	**6.4%**	**3.6%**	**4.7%**	**100.0%**
Colorectal Cancer (ICD 153-4)						
Age 0-14	$126	$0	$0	$0	$0	$126
Age15-29	$640	$0	$326	$13	$0	$979
Age 30-44	$5,059	$253	$956	$513	$338	$7,119
Age 45-59	$21,072	$2,482	$2,535	$2,567	$2,106	$30,762
Age 60-74	$15,938	$42,165	$1,232	$1,312	$2,185	$62,832
Age 75+	$5,207	$52,830	$515	$292	$766	$59,610
Total	**$48,042**	**$97,730**	**$5,564**	**$4,697**	**$5,395**	**$161,428**
Percent	**29.8%**	**60.5%**	**3.4%**	**2.9%**	**3.3%**	**100.0%**
Lung Cancer (ICD 162)						
Age 0-14	$43	$0	$83	$0	$0	$126
Age15-29	$191	$0	$687	$74	$128	$1,080
Age 30-44	$3,638	$538	$1,353	$884	$776	$7,189
Age 45-59	$29,936	$4,047	$4,544	$2,853	$2,821	$44,201
Age 60-74	$28,790	$75,699	$3,179	$3,080	$5,065	$115,813
Age 75+	$5,864	$51,506	$385	$455	$1,429	$59,639
Total	**$68,462**	**$131,790**	**$10,231**	**$7,346**	**$10,219**	**$228,048**
Percent	**30.0%**	**57.8%**	**4.5%**	**3.2%**	**4.5%**	**100.0%**
Breast Cancer (ICD 174)						
Age 0-14	$0	$0	$0	$0	$0	$0
Age15-29	$432	$0	$885	$0	$14	$1,331
Age 30-44	$15,160	$604	$2,032	$1,264	$980	$20,040
Age 45-59	$22,885	$1,444	$2,501	$2,460	$2,043	$31,333
Age 60-74	$6,723	$13,229	$364	$1,036	$1,051	$22,403
Age 75+	$1,747	$13,886	$110	$251	$171	$16,165
Total	**$46,947**	**$29,163**	**$5,892**	**$5,011**	**$4,259**	**$91,272**
Percent	**51.4%**	**32.0%**	**6.5%**	**5.5%**	**4.7%**	**100.0%**
Prostate Cancer (ICD 185)						
Age 0-14	$0	$68	$15	$0	$0	$83
Age15-29	$14	$0	$0	$30	$0	$44
Age 30-44	$230	$0	$0	$0	$0	$230
Age 45-59	$9,134	$916	$208	$317	$610	$11,185
Age 60-74	$11,658	$26,612	$387	$582	$1,626	$40,865
Age 75+	$3,409	$41,195	$50	$89	$1,008	$45,751
Total	**$24,445**	**$68,791**	**$660**	**$1,018**	**$3,244**	**$98,158**
Percent	**24.9%**	**70.1%**	**0.7%**	**1.0%**	**3.3%**	**100.0%**
Other Cancers						
Age 0-14	$26,956	$71	$29,866	$3,082	$2,756	$62,731
Age15-29	$37,105	$1,820	$15,903	$4,780	$7,480	$67,088
Age 30-44	$147,806	$10,815	$19,721	$11,875	$15,028	$205,245
Age 45-59	$214,194	$25,531	$21,123	$18,826	$19,196	$298,870
Age 60-74	$99,465	$239,062	$8,677	$9,167	$14,592	$370,963
Age 75+	$22,039	$238,973	$800	$1,613	$5,346	$268,771
Total	**$547,565**	**$516,272**	**$96,090**	**$49,343**	**$64,398**	**$1,273,668**
Percent	**43.0%**	**40.5%**	**7.5%**	**3.9%**	**5.1%**	**100.0%**

Table 6. Top 25 Hospitals with the Most Cancer-Related Discharges of Texas Residents, Annualized Costs, FY 1998

Facility	Location	Discharges	Costs
M.D. Anderson	Houston	8,612	141,699,883
Baylor University Medical Center	Dallas	5,288	72,125,337
The Methodist Hospital	Houston	5,160	58,273,350
Southwest Texas Methodist Hospital	San Antonio	4,252	45,232,654
Harris Methodist	Ft Worth	3,368	32,399,102
Medical City Dallas Hospital	Dallas	3,360	41,334,581
Presbyterian Hospital	Dallas	3,348	39,749,100
St. Luke Episcopal	Houston	3,316	29,653,397
Univ. of Texas Medical Branch Hospital	Galveston	3,088	35,823,706
Seton Medical Center	Austin	3,044	27,973,216
Scott & White Memorial Hospital	Temple	2,980	33,310,872
Dallas County Hospital District	Dallas	2,828	20,424,852
Methodist Hospital	Lubbock	2,592	21,081,623
St Elizabeth Hospital	Beaumont	2,512	20,049,656
Memorial Hospital Southwest	Houston	2,460	23,683,918
Christus Spohn Shoreline	Corpus Christi	2,200	14,901,142
St Joseph Hospital	Houston	2,148	20,740,612
Providence Memorial Hospital	El Paso	2,136	16,911,361
Houston Northwest Medical Center	Houston	2,124	18,893,767
Trinity Mother Frances	Tyler	2,124	17,822,782
Memorial Hospital-Mem. City	Houston	2,020	13,683,212
Arlington Memorial Hospital	Arlington	1,904	14,227,700
St Paul Medical Center	Dallas	1,884	19,704,758
Hendrick Medical Center	Abilene	1,840	20,167,129
University Health System	San Antonio	1,784	19,111,245
Total		**76,372**	**$818,978,953**
Percent of Statewide		**38%**	**44%**

Table 6 lists the 25 hospitals in Texas which, on an annualized basis, discharged the greatest numbers of patients with cancer. These 25 facilities, located in the metropolitan and large urban areas, accounted for 38 percent of the cancer-related discharges of Texas residents, and 44 percent of the associated costs.

Table 7 compares Texas residents and non-residents discharged from M.D. Anderson Hospital. Non-residents constituted a large share of the patients. Average cost for resident breast cancer patients was somewhat larger than the average for non-residents. Table 8 compares discharges where cancer was the principal diagnosis with discharges where cancer was a secondary diagnosis. In cases of colorectal, lung and "other" types of cancer, average costs were higher when the disease was the primary diagnosis. Table 9 presents findings for public health region of residence for cancer patients.

Table 7. Annualized Hospital Stays and Estimated Facility Costs for Treatment of Patients with Selected Cancers by Residency, M.D. Anderson Hospital, FY 1998

	Residents	Non-Residents	Total
Any Cancer (ICD 140-239)			
Number of Stays	8,612	5,860	14,472
Patient Days	66,156	45,624	111,780
Average Days of Stay	7.68	7.79	7.72
Estimated Cost	$141,699,883	$106,415,117	$248,115,000
Average Cost Per Stay	$16,454	$18,160	$17,144
Colorectal Cancer (ICD 153-4)			
Number of Stays	200	148	348
Patient Days	1628	1,160	2,788
Average Days of Stay	8.14	7.84	8.01
Estimated Cost	$3,226,101	$2,398,899	$5,625,000
Average Cost Per Stay	$16,131	$16,209	$16,164
Lung Cancer (ICD 162)			
Number of Stays	408	216	624
Patient Days	2,568	1,384	3,952
Average Days of Stay	6.29	6.41	6.33
Estimated Cost	$6,985,380	$3,937,620	$10,923,000
Average Cost Per Stay	$17,121	$18,230	$17,505
Breast Cancer (ICD 174)			
Number of Stays	216	164	380
Patient Days	1,280	928	2,208
Average Days of Stay	5.93	5.66	5.81
Estimated Cost	$4,567,440	$2,457,560	$7,025,000
Average Cost Per Stay	$21,146	$14,985	$18,487
Prostate Cancer (ICD 185)			
Number of Stays	300	172	472
Patient Days	1,964	1,220	3,184
Average Days of Stay	6.55	7.09	6.75
Estimated Cost	$2,598,716	$1,589,284	$4,188,000
Average Cost Per Stay	$8,662	$9,240	$8,873
Other Cancers			
Number of Stays	7,488	5,160	12,648
Patient Days	58,716	40,932	99,648
Average Days of Stay	7.84	7.93	7.88
Estimated Cost	$124,322,246	$96,031,754	$220,354,000
Average Cost Per Stay	$16,603	$18,611	$17,422

Table 8. Annualized Hospital Stays and Estimated Facility Costs for Treatment of Selected Cancers Among Texas Residents by Position of Cancer Diagnosis, M.D. Anderson Hospital, FY 1998

	Principal Diagnosis	Secondary Diagnosis	Total
Any Cancer (ICD 140-239)			
Number of Stays	4,064	4,548	14,472
Patient Days	33,948	32,208	111,780
Average Days of Stay	8.35	7.08	7.72
Estimated Cost	$85,249,857	$56,450,026	$248,115,000
Average Cost Per Stay	$20,977	$12,412	$17,144
Colorectal Cancer (ICD 153-4)			
Number of Stays	128	72	200
Patient Days	1112	516	1,628
Average Days of Stay	8.69	7.17	8.14
Estimated Cost	$2,242,862	$983,240	$3,226,101
Average Cost Per Stay	$17,522	$13,656	$16,131
Lung Cancer (ICD 162)			
Number of Stays	256	152	408
Patient Days	1524	1,044	2,568
Average Days of Stay	5.95	6.87	6.29
Estimated Cost	$5,064,236	$1,921,144	$6,985,380
Average Cost Per Stay	$19,782	$12,639	$17,121
Breast Cancer (ICD 174)			
Number of Stays	156	60	216
Patient Days	896	384	1,280
Average Days of Stay	5.74	6.40	5.93
Estimated Cost	$3,140,728	$1,426,712	$4,567,440
Average Cost Per Stay	$20,133	$23,779	$21,146
Prostate Cancer (ICD 185)			
Number of Stays	232	68	300
Patient Days	1224	740	1,964
Average Days of Stay	5.28	10.88	6.55
Estimated Cost	$1,959,075	$639,641	$2,598,716
Average Cost Per Stay	$8,444	$9,406	$8,662
Other Cancers			
Number of Stays	3292	4,196	7,488
Patient Days	29192	29,524	58,716
Average Days of Stay	8.87	7.04	7.84
Estimated Cost	$72,842,956	$51,479,290	$124,322,246
Average Cost Per Stay	$22,127	$12,269	$16,603

Table 9. Estimated Cancer Hospitalizations and Facility Costs by Public Health Region of Residence, Texas, 1998

Region		All Cancers	Colorectal	Lung	Breast	Prostate	Other
1	Hospital Stays	7,180	404	640	384	424	5,328
	Cost (x $1,000)	$58,488	$4,686	$5,866	$2,692	$3,146	$42,098
	% of Total Cost	3.2%	2.9%	2.6%	3.2%	3.2%	3.3%
2	Hospital Stays	6,384	432	872	240	396	4,444
	Cost (x $1,000)	$60,589	$5,658	$8,383	$2,059	$2,774	$41,715
	% of Total Cost	3.3%	3.5%	3.7%	2.4%	2.8%	3.3%
3	Hospital Stays	50,700	3,320	5,508	2,728	3,012	36,132
	Cost (x $1,000)	$488,346	$43,412	$63,018	$23,030	$24,735	$334,151
	% of Total Cost	26.6%	26.9%	27.7%	27.2%	25.3%	26.4%
4	Hospital Stays	11,632	1,016	1,584	600	876	7,556
	Cost (x $1,000)	$105,550	$12,336	$16,583	$3,909	$6,216	$66,506
	% of Total Cost	5.7%	7.6%	7.3%	4.6%	6.3%	5.3%
5	Hospital Stays	10,852	848	1,564	600	1,072	6,768
	Cost (x $1,000)	$92,888	$9,481	$14,845	$3,697	$7,355	$57,509
	% of Total Cost	5.1%	5.9%	6.5%	4.4%	7.5%	4.5%
6	Hospital Stays	47,808	3,128	5,124	2,580	2,800	34,176
	Cost (x $1,000)	$474,219	$38,979	$55,966	$22,536	$21,835	$334,902
	% of Total Cost	25.8%	24.1%	24.6%	26.6%	22.3%	26.5%
7	Hospital Stays	18,936	1,260	2,072	1,104	1,244	13,256
	Cost (x $1,000)	$163,322	$15,424	$20,167	$7,881	$8,937	$110,914
	% of Total Cost	8.9%	9.5%	8.9%	9.3%	9.1%	8.8%
8	Hospital Stays	18,460	1,080	1,816	1,160	1,284	13,120
	Cost (x $1,000)	$160,769	$12,544	$17,983	$8,464	$8,392	$113,385
	% of Total Cost	8.8%	7.8%	7.9%	10.0%	8.6%	9.0%
9	Hospital Stays	5,500	280	588	228	392	4,012
	Cost (x $1,000)	$49,367	$3,500	$5,983	$1,766	$3,006	$35,111
	% of Total Cost	2.7%	2.2%	2.6%	2.1%	3.1%	2.8%
10	Hospital Stays	7,052	388	588	384	500	5,192
	Cost (x $1,000)	$60,740	$4,808	$5,531	$2,578	$4,221	$43,601
	% of Total Cost	3.3%	3.0%	2.4%	3.0%	4.3%	3.4%
11	Hospital Stays	16,284	1,120	1,588	988	1,164	11,424
	Cost (x $1,000)	$122,558	$10,840	$13,390	$6,013	$7,313	$85,002
	% of Total Cost	6.7%	6.7%	5.9%	7.1%	7.5%	6.7%
Total	Hospital Stays	200,788	13,276	21,944	10,996	13,164	141,408
	Cost (x $1,000)	$1,836,836	$161,668	$227,715	$84,625	$97,930	$1,264,894
	% of Total Cost	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Totals exclude hospitalizations with place of Texas residence unknown.

Discussion

This report is based on discharges during the first calendar quarter of 1999. All figures are annualized and represented as covering fiscal year 1998. Clearly, admissions and discharges change over time at the various hospitals, and it is likely that individual facilities had higher or lower counts of the number of discharges during that period. Also, while it is possible that the calendar quarter of study was not representative, it seems unlikely that cancer admissions follow any seasonal pattern.

Also, a number of small community hospitals, representing 6 percent of the civilian hospital beds in Texas, did not participate in the survey. We do not believe it appropriate to inflate the figures to account for the missing beds, as we believe that those facilities had relatively few cancer patients. Of greater concern is the absence of information on military and veterans' hospitals, which do serve a large number of Texans.

Most of the tables in this report include discharges with cancer as either principal or secondary diagnosis, without distinguishing between the two types of discharges. Certainly, some of the "secondary" cases were hospitalized for reasons other than cancer, and allowance should be made for hospitalizations of persons with cancer which would have taken place even in the absence of the cancer. However, exclusion of cases where cancer was a secondary diagnosis would result in even greater error in the opposite direction. Many discharges listed a principal diagnosis other than cancer, but which is nevertheless due to cancer or substantially complicated by cancer. There are also probably a smaller number of discharges in which the underlying cause of admission was cancer but it was not listed among the diagnoses.

The financial figures presented are not charges, but estimates of costs. The cost estimates are, for the most part, based on Medicaid payment policies and the DRGs for the respective hospitalizations. While Medicaid payment levels may differ from costs, they are at least in principle tied to costs for each hospital. We made no adjustments in the Medicaid rates for additional payments to disproportionate share hospitals. But on the other hand, we attributed these costs to all discharged patients, whether they could pay or not. Individual hospitals that develop cost estimates using alternative methods will obtain different results.

References

1. Thom, Thomas J. "Economic Costs of Neoplasms, Arteriosclerosis, and Diabetes in the United States." *In Vivo*, vol. 10, no. 2 (1996), pp. 255-260.

2. Williams, Anna F., and Charles E. Begley. "The Cost of Cancer in Texas." *Texas Medicine*, vol. 88, no. 6 (1992), pp. 62-67.

Appendix A

Ethnicity, Gender, and Age of Hospital Patients with Cancer, Texas Residents, FY 1998

	White/Other			*Black*			*Hispanic*			*Total*		
	Male	**Female**	**Subtotal**	**Male**	**Female**	**Subtotal**	**Male**	**Female**	**Subtotal**	**Male**	**Female**	**Subtotal**
Any Cancer (ICD 140-239)												
Age 0-14	1,868	1,644	3,512	304	280	584	1,196	1,140	2,336	3,368	3,064	6,432
Age15-29	1,512	2,480	3,992	376	936	1,312	952	1,340	2,292	2,840	4,756	7,596
Age 30-44	3,684	14,288	17,972	824	5,484	6,308	1,440	5,280	6,720	5,948	25,052	31,000
Age 45-59	11,124	20,004	31,128	2,240	3,696	5,936	2,684	5,268	7,952	16,048	28,968	45,016
Age 60-74	24,348	22,752	47,100	3,064	3,592	6,656	4,384	4,428	8,812	31,796	30,772	62,568
Age 75+	18,488	19,876	38,364	2,136	2,628	4,764	2,944	2,688	5,632	23,568	25,192	48,760
Total	**61,024**	**81,044**	**142,068**	**8,944**	**16,616**	**25,560**	**13,600**	**20,144**	**33,744**	**83,568**	**117,804**	**201,372**
Colorectal Cancer (ICD 153-4)												
Age 0-14	4	8	12	0	0	0	0	0	0	4	8	12
Age15-29	24	40	64	8	0	8	8	12	20	40	52	92
Age 30-44	216	148	364	64	36	100	80	76	156	360	260	620
Age 45-59	816	864	1,680	268	196	464	312	212	524	1,396	1,272	2,668
Age 60-74	2,060	1,820	3,880	252	300	552	376	296	672	2,688	2,416	5,104
Age 75+	1,552	2,260	3,812	160	332	492	260	232	492	1,972	2,824	4,796
Total	**4,672**	**5,140**	**9,812**	**752**	**864**	**1,616**	**1,036**	**828**	**1,864**	**6,460**	**6,832**	**13,292**
Lung Cancer (ICD 162)												
Age 0-14	4	4	8	4	0	4	0	0	0	8	4	12
Age15-29	12	4	16	4	12	16	8	16	24	24	32	56
Age 30-44	240	168	408	104	24	128	68	4	72	412	196	608
Age 45-59	1,628	1,508	3,136	348	264	612	284	148	432	2,260	1,920	4,180
Age 60-74	4,824	4,068	8,892	688	480	1,168	712	316	1,028	6,232	4,864	11,096
Age 75+	2,752	2,084	4,836	280	184	464	444	280	724	3,476	2,548	6,024
Total	**9,460**	**7,836**	**17,296**	**1,428**	**964**	**2,392**	**1,516**	**764**	**2,280**	**12,412**	**9,564**	**21,976**
Breast Cancer (ICD 174)												
Age 0-14	0	0	0	0	0	0	0	0	0	0	0	0
Age15-29	0	32	32	0	4	4	0	32	32	0	68	68
Age 30-44	0	1,048	1,048	0	276	276	0	348	348	0	1,672	1,672
Age 45-59	0	2,400	2,400	0	452	452	0	680	680	0	3,532	3,532
Age 60-74	0	2,640	2,640	0	288	288	0	500	500	0	3,428	3,428
Age 75+	0	2,000	2,000	0	220	220	0	164	164	0	2,384	2,384
Total	**0**	**8,120**	**8,120**	**0**	**1,240**	**1,240**	**0**	**1,724**	**1,724**	**0**	**11,084**	**11,084**
Prostate Cancer (ICD 185)												
Age 0-14	8	0	8	8	0	8	0	0	0	16	0	16
Age15-29	8	0	8	0	0	0	0	0	0	8	0	8
Age 30-44	8	0	8	24	0	24	8	0	8	40	0	40
Age 45-59	1,260	0	1,260	212	0	212	196	0	196	1,668	0	1,668
Age 60-74	4,184	0	4,184	652	0	652	796	0	796	5,632	0	5,632
Age 75+	4,436	0	4,436	776	0	776	616	0	616	5,828	0	5,828
Total	**9,904**	**0**	**9,904**	**1,672**	**0**	**1,672**	**1,616**	**0**	**1,616**	**13,192**	**0**	**13,192**
Other Cancers												
Age 0-14	1,852	1,632	3,484	292	280	572	1,196	1,140	2,336	3,340	3,052	6,392
Age15-29	1,468	2,404	3,872	364	920	1,284	936	1,280	2,216	2,768	4,604	7,372
Age 30-44	3,220	12,924	16,144	632	5,148	5,780	1,284	4,852	6,136	5,136	22,924	28,060
Age 45-59	7,420	15,232	22,652	1,412	2,784	4,196	1,892	4,228	6,120	10,724	22,244	32,968
Age 60-74	13,280	14,224	27,504	1,472	2,524	3,996	2,500	3,316	5,816	17,256	20,064	37,320
Age 75+	9,748	13,532	23,280	920	1,892	2,812	1,624	2,012	3,636	12,292	17,448	29,740
Total	**36,988**	**59,948**	**96,936**	**5,092**	**13,548**	**18,640**	**9,432**	**16,828**	**26,260**	**51,516**	**90,336**	**141,852**

Notes: *Raw data contained two cases of females with prostate cancer who were re-classified as male.*
Raw data total for lung cancer, males ages 60-74, contained two cases of ethnicity unknown.
Raw data total for other cancers, males ages 60-74, contained one case of ethnicity unknown.
Raw data total for other cancers, females ages 75+, contained three cases of ethnicity unknown.
Persons hospitalized more than once are counted for each hospitalization.

Appendix B

Estimated Inpatient Costs for Persons with Cancer by Ethnicity, Gender, and Age, FY 1998

	White/Other			*Black*		
	Male	**Female**	**Subtotal**	**Male**	**Female**	**Subtotal**
Any Cancer (ICD 140-239)						
Age 0-14	$17,284,000	$14,306,000	$31,590,000	$1,836,000	$3,738,000	$5,574,000
Age15-29	$18,651,000	$19,233,000	$37,884,000	$3,921,000	$6,120,000	$10,041,000
Age 30-44	$45,012,000	$103,309,000	$148,321,000	$8,862,000	$32,908,000	$41,770,000
Age 45-59	$128,900,000	$169,720,000	$298,620,000	$23,290,000	$27,904,000	$51,194,000
Age 60-74	$250,168,000	$217,280,000	$467,448,000	$31,340,000	$34,820,000	$66,160,000
Age 75+	$174,821,000	$183,512,000	$358,333,000	$19,887,000	$24,206,000	$44,093,000
Total	**$634,836,000**	**$707,360,000**	**$1,342,196,000**	**$89,136,000**	**$129,696,000**	**$218,832,000**
Colorectal Cancer (ICD 153-4)						
Age 0-14	$36,000	$90,000	$126,000	$0	$0	$0
Age15-29	$308,000	$308,000	$616,000	$132,000	$0	$132,000
Age 30-44	$2,722,000	$1,820,000	$4,542,000	$609,000	$373,000	$982,000
Age 45-59	$10,221,000	$10,116,000	$20,337,000	$2,900,000	$2,173,000	$5,073,000
Age 60-74	$25,740,000	$21,933,000	$47,673,000	$3,255,000	$4,076,000	$7,331,000
Age 75+	$19,674,000	$28,604,000	$48,278,000	$2,109,000	$3,994,000	$6,103,000
Total	**$58,701,000**	**$62,871,000**	**$121,572,000**	**$9,005,000**	**$10,616,000**	**$19,621,000**
Lung Cancer (ICD 162)						
Age 0-14	$26,000	$17,000	$43,000	$83,000	$0	$83,000
Age15-29	$161,000	$23,000	$184,000	$20,000	$186,000	$206,000
Age 30-44	$3,434,000	$1,787,000	$5,221,000	$940,000	$441,000	$1,381,000
Age 45-59	$17,787,000	$16,070,000	$33,857,000	$3,678,000	$2,787,000	$6,465,000
Age 60-74	$50,774,000	$42,670,000	$93,444,000	$7,500,000	$4,856,000	$12,356,000
Age 75+	$27,828,000	$20,452,000	$48,280,000	$2,605,000	$1,620,000	$4,225,000
Total	**$100,010,000**	**$81,019,000**	**$181,029,000**	**$14,826,000**	**$9,890,000**	**$24,716,000**
Breast Cancer (ICD 174)						
Age 0-14	$0	$0	$0	$0	$0	$0
Age15-29	$0	$668,000	$668,000	$0	$14,000	$14,000
Age 30-44	$0	$13,545,000	$13,545,000	$0	$3,417,000	$3,417,000
Age 45-59	$0	$22,648,000	$22,648,000	$0	$2,986,000	$2,986,000
Age 60-74	$0	$17,364,000	$17,364,000	$0	$2,054,000	$2,054,000
Age 75+	$0	$13,756,000	$13,756,000	$0	$1,518,000	$1,518,000
Total	**$0**	**$67,981,000**	**$67,981,000**	**$0**	**$9,989,000**	**$9,989,000**
Prostate Cancer (ICD 185)						
Age 0-14	$68,000	$0	$68,000	$15,000	$0	$15,000
Age15-29	$43,000	$0	$43,000	$0	$0	$0
Age 30-44	$38,000	$0	$38,000	$131,000	$0	$131,000
Age 45-59	$8,190,000	$0	$8,190,000	$1,477,000	$0	$1,477,000
Age 60-74	$30,034,000	$0	$30,034,000	$5,213,000	$0	$5,213,000
Age 75+	$35,018,000	$0	$35,018,000	$6,478,000	$0	$6,478,000
Total	**$73,391,000**	**$0**	**$73,391,000**	**$13,314,000**	**$0**	**$13,314,000**
Other Cancers						
Age 0-14	$17,154,000	$14,199,000	$31,353,000	$1,738,000	$3,738,000	$5,476,000
Age15-29	$18,139,000	$18,234,000	$36,373,000	$3,769,000	$5,920,000	$9,689,000
Age 30-44	$38,818,000	$86,157,000	$124,975,000	$7,182,000	$28,677,000	$35,859,000
Age 45-59	$92,702,000	$120,886,000	$213,588,000	$15,235,000	$19,958,000	$35,193,000
Age 60-74	$143,620,000	$135,313,000	$278,933,000	$15,372,000	$23,834,000	$39,206,000
Age 75+	$92,301,000	$120,700,000	$213,001,000	$8,695,000	$17,074,000	$25,769,000
Total	**$402,734,000**	**$495,489,000**	**$898,223,000**	**$51,991,000**	**$99,201,000**	**$151,192,000**

Notes: *Raw data contained 2 cases of females with prostate cancer who were re-classified as male.*
Raw data total for lung cancer, males ages 60-74, contained 2 cases ethnicity unknown.
Raw data total for other cancers, males ages 60-74, contained 1 case ethnicity unknown.
Raw data total for other cancers, females ages 75+, contained 3 cases ethnicity unknown.

Appendix B, continued

	Hispanic			*Total*		
	Male	**Female**	**Subtotal**	**Male**	**Female**	**Subtotal**
Any Cancer (ICD 140-239)						
Age 0-14	$14,330,000	$11,573,000	$25,903,000	$33,450,000	$29,617,000	$63,067,000
Age15-29	$12,054,000	$10,546,000	$22,600,000	$34,626,000	$35,899,000	$70,525,000
Age 30-44	$16,299,000	$33,431,000	$49,730,000	$70,173,000	$169,648,000	$239,821,000
Age 45-59	$26,853,000	$39,684,000	$66,537,000	$179,043,000	$237,308,000	$416,351,000
Age 60-74	$40,644,000	$38,624,000	$79,268,000	$322,152,000	$290,724,000	$612,876,000
Age 75+	$24,867,000	$22,642,000	$47,509,000	$219,575,000	$230,360,000	$449,935,000
Total	**$135,047,000**	**$156,500,000**	**$291,547,000**	**$859,019,000**	**$993,556,000**	**$1,852,575,000**
Colorectal Cancer (ICD 153-4)						
Age 0-14	$0	$0	$0	$36,000	$90,000	$126,000
Age15-29	$105,000	$127,000	$232,000	$545,000	$434,000	$979,000
Age 30-44	$909,000	$686,000	$1,595,000	$4,241,000	$2,879,000	$7,120,000
Age 45-59	$3,191,000	$2,162,000	$5,353,000	$16,312,000	$14,451,000	$30,763,000
Age 60-74	$4,154,000	$3,673,000	$7,827,000	$33,149,000	$29,683,000	$62,832,000
Age 75+	$2,644,000	$2,584,000	$5,228,000	$24,427,000	$35,183,000	$59,610,000
Total	**$11,003,000**	**$9,232,000**	**$20,235,000**	**$78,710,000**	**$82,720,000**	**$161,430,000**
Lung Cancer (ICD 162)						
Age 0-14	$0	$0	$0	$109,000	$17,000	$126,000
Age15-29	$46,000	$646,000	$692,000	$227,000	$854,000	$1,081,000
Age 30-44	$556,000	$30,000	$586,000	$4,930,000	$2,258,000	$7,188,000
Age 45-59	$2,516,000	$1,362,000	$3,878,000	$23,981,000	$20,220,000	$44,201,000
Age 60-74	$6,356,000	$3,658,000	$10,014,000	$64,630,000	$51,184,000	$115,814,000
Age 75+	$4,484,000	$2,650,000	$7,134,000	$34,917,000	$24,722,000	$59,639,000
Total	**$13,958,000**	**$8,346,000**	**$22,304,000**	**$128,794,000**	**$99,255,000**	**$228,049,000**
Breast Cancer (ICD 174)						
Age 0-14	$0	$0	$0	$0	$0	$0
Age15-29	$0	$649,000	$649,000	$0	$1,331,000	$1,331,000
Age 30-44	$0	$3,078,000	$3,078,000	$0	$20,040,000	$20,040,000
Age 45-59	$0	$5,700,000	$5,700,000	$0	$31,334,000	$31,334,000
Age 60-74	$0	$2,985,000	$2,985,000	$0	$22,403,000	$22,403,000
Age 75+	$0	$891,000	$891,000	$0	$16,165,000	$16,165,000
Total	**$0**	**$13,303,000**	**$13,303,000**	**$0**	**$91,273,000**	**$91,273,000**
Prostate Cancer (ICD 185)						
Age 0-14	$0	$0	$0	$84,000	$0	$84,000
Age15-29	$0	$0	$0	$43,000	$0	$43,000
Age 30-44	$60,000	$0	$60,000	$230,000	$0	$230,000
Age 45-59	$1,518,000	$0	$1,518,000	$11,185,000	$0	$11,185,000
Age 60-74	$5,617,000	$0	$5,617,000	$40,865,000	$0	$40,865,000
Age 75+	$4,255,000	$0	$4,255,000	$45,750,000	$0	$45,750,000
Total	**$11,450,000**	**$0**	**$11,450,000**	**$98,157,000**	**$0**	**$98,157,000**
Other Cancers						
Age 0-14	$14,330,000	$11,573,000	$25,903,000	$33,223,000	$29,509,000	$62,732,000
Age15-29	$11,903,000	$9,124,000	$21,027,000	$33,811,000	$33,278,000	$67,089,000
Age 30-44	$14,774,000	$29,637,000	$44,411,000	$60,773,000	$144,471,000	$205,244,000
Age 45-59	$19,628,000	$30,460,000	$50,088,000	$127,566,000	$171,304,000	$298,870,000
Age 60-74	$24,517,000	$28,308,000	$52,825,000	$183,509,000	$187,455,000	$370,964,000
Age 75+	$13,484,000	$16,517,000	$30,001,000	$114,480,000	$154,291,000	$268,771,000
Total	**$98,636,000**	**$125,619,000**	**$224,255,000**	**$553,362,000**	**$720,308,000**	**$1,273,670,000**

Notes: *Raw data contained 2 cases of females with prostate cancer who were re-classified as male.*
Raw data total for lung cancer, males ages 60-74, contained 2 cases ethnicity unknown.
Raw data total for other cancers, males ages 60-74, contained 1 case ethnicity unknown.
Raw data total for other cancers, females ages 75+, contained 3 cases ethnicity unknown.

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