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CONNECTICUT OFFICE OF
HEALTH CARE ACCESS

GREENWICH HOSPITAL
YALE NEW HAVEN HEALTH

October 28, 2010

Honorable Norma Gyle
Deputy Commissioner
Office of Health Care Access
410 Capitol Avenue, MS#13HCA
P.O. Box 340308
Hartford, CT 06134-0308

Dear Deputy Commissioner Gyle:

Enclosed please find an original Certificate of Need application for Docket Number 10-31647 CON as well as four hard copies and a CD from Greenwich Hospital for the acquisition of a CT Simulator.

Thank you in advance for your consideration of this project. If you have any questions, please call me at (203) 863-3909.

Sincerely,

Nancy M. Hamson

Nancy M. Hamson
Director of Planning

CC: Frank A. Corvino, Greenwich Hospital

REQUEST FOR NEW CERTIFICATE OF NEED

FILING FEE COMPUTATION SCHEDULE

APPLICANT: Greenwich Hospital PROJECT TITLE: Acquisition of a CT Simulator DATE: Oct 2010	FOR OHCA USE ONLY: 1. Check logged (Front desk) — DATE 11.2.10 INITIAL Lmg 2. Check rec'd (Clerical/Cert.) — 6 3. Check correct (Superv.) — 11-2-10 4. Check logged (Clerical/Cert).)

SECTION A – NEW CERTIFICATE OF NEED APPLICATION

1. Check statute reference as applicable to CON application (see statute for detail):

_____ 19a-638.Additional function or service, change of ownership, service termination.
No Fee Required.

_____ 19a-639 Capital expenditure exceeding $3,000,000, or capital expenditure exceeding $3,000,000 for major medical equipment, or CT scanner, PET scanner, PET/CT scanner, MRI scanner, cineangiography equipment or linear accelerator.
Fee Required.

_____ 19a-638 and 19a-639.
Fee Required.

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2. Enter $0 on "Total Fee Due" line (SECTION B) if application is required pursuant to Section 19a-638 only, otherwise go on to line 3 of this section.

3. Enter $400 on "Total Fee Due" line (SECTION B) if application is for capital expenditure for major medical equipment, imaging equipment or linear accelerator less than $3,000,000

4. Section 19a-639 fee calculation (applicable if section 19a-639 capital expenditure for major medical equipment, imaging equipment or linear accelerator exceeding $3,000,000 or other capital expenditure exceeding $3,000,000 is checked above **OR** if both 19a-638 and 19a-639 are checked):
   a. Base fee: _____ $ 1,000.00
   b. Additional Fee: (Capital Expenditure Assessment) _____ $ _____.00
   (To calculate: Total requested Capital Expenditure/Cost excluding capitalized financing costs multiplied times .0005 and round to nearest dollar.) ($_____ x .0005) $_____.00
   c. Sum of base fee plus additional fee: (Lines A4a + A4b) _____
   d. Enter the amount shown on line A4c. on "Total Fee Due" line (SECTION B).

Flat Fee of $500 ✓

SECTION B TOTAL FEE DUE:

179565

GHA Federal Credit Union
5 Perryridge Road
Greenwich, CT 06830
Phone: 203-863-3186

CONSTITUTION STATE CORPORATE CREDIT UNION, INC
WALLINGFORD, CT 06492
51-9194/2111

DATE 10/28/10
VOID AFTER 90 DAYS

PAY ********** FIVE HUNDRED DOLLARS AND NO CENTS **********

AMOUNT ********500.00**

PAY TO THE ORDER OF TREASURER STATE OF CONNECTICUT
GREENWICH HOSPITAL CT SIMULATOR CON

Dana P Sapersten
AUTHORIZED SIGNATURE

OFFICE OF HEALTH CARE ACCESS

REQUEST FOR NEW CERTIFICATE OF NEED

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Fee Required.

_____ 19a-638 and 19a-639.
Fee Required.

2. Enter $0 on "Total Fee Due" line (SECTION B) if application is required pursuant to Section 19a-638 only, otherwise go on to line 3 of this section.

3. Enter $400 on "Total Fee Due" line (SECTION B) if application is for capital expenditure for major medical equipment, imaging equipment or linear accelerator less than $3,000,000

4. Section 19a-639 fee calculation (applicable if section 19a-639 capital expenditure for major medical equipment, imaging equipment or linear accelerator exceeding $3,000,000 or other capital expenditure exceeding $3,000,000 is checked above **OR** if both 19a-638 and 19a-639 are checked):
   a. Base fee: _____ $ 1,000.00
   b. Additional Fee: (Capital Expenditure Assessment) _____ $_____.00
   (To calculate: Total requested Capital Expenditure/Cost excluding capitalized financing costs multiplied times .0005 and round to nearest dollar.) ($_____ x .0005)
   c. Sum of base fee plus additional fee: (Lines A4a + A4b) _____ $_____.00
   d. Enter the amount shown on line A4c. on "Total Fee Due" line (SECTION B).

SECTION B TOTAL FEE DUE: _____ $ 500.00

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ATTACH HERE CERTIFIED OR CASHIER'S CHECK ONLY (Payable to: Treasurer, State of Connecticut)

State of Connecticut
Office of Health Care Access
Certificate of Need Application

Please complete all questions. If any question is not relevant to your project, a response of "Not Applicable" may be an acceptable answer. Your Certificate of Need application will be eligible for submission no earlier than September 4, 2010, and may be submitted no later than November 3, 2010. The OHCA analyst assigned to your application is Jack A. Huber. He may be reached at the Office of Health Care Access at (860) 418-7034.

Docket Number:	10-31647-CON
Applicant Name:	Greenwich Hospital
Contact Person:	Nancy M. Hamson
Contact Title:	Director of Planning
Contact Address:	5 Perryridge Road Greenwich, CT 06830
Project Location:	Greenwich
Project Name:	Acquisition of a CT Simulator
Proposal Type:	Section 19a-639, C.G.S.
Estimated Total Capital Cost:	$1,320,201

1. Project Description and Need

A. Provide a narrative detailing the proposal.

Greenwich Hospital is a progressive medical center offering a wide range of medical, surgical, diagnostic and preventive programs. A member of the Yale New Haven Health System, Greenwich Hospital is a community teaching hospital, affiliated with the Yale University School of Medicine. Greenwich Hospital is committed to providing the highest quality of care to the communities it serves. The Bendheim Cancer Center, part of Greenwich Hospital, is an outpatient diagnostic and treatment facility, combining advanced technology with a nurturing environment to bring the highest standard of cancer care and support services to patients and their families. The center provides comprehensive services that enable patients with cancer to receive complex and sophisticated treatment on an outpatient basis.

One of the many services provided at the Bendheim Cancer Center is radiation therapy. An integral part of radiation therapy is treatment planning. To enhance quality of care and support the recently installed new linear accelerator, Greenwich Hospital seeks to acquire a CT simulator to perform onsite 3-dimensional imaging and radiation treatment planning for patients. CT simulation uses the patient's CT scan to produce 3-dimensional images of the patient's tumor, along with the surrounding normal tissue, so that the radiation oncologist can map the area to be treated with a high degree of accuracy and spare as much of the surrounding healthy tissue as possible during treatment. Having this capability on-site at the Bendheim Cancer Center increases quality of care as well as convenience for a fragile patient population.

A CT simulator is a highly specific piece of equipment for dedicated radiation therapy imaging for treatment planning. The CT simulator, unlike the diagnostic scanner, is equipped with specialized patient localization and planning software that enables the radiation therapy team to accurately set up and mark the patient for treatment. The CT simulator set-up can then be accurately reproduced in the treatment room in order to deliver the prescribed doses according to the treatment plan.

An onsite CT simulator is optimal during the course of a patient's radiation treatment. While the patient is receiving his/her treatment planning CT scan, the radiation oncologist and other members of the treatment team, such as dosimetrists and physicists, should ideally be onsite and available for consultation. This is considered industry best practice and is the norm for oncology treatment centers. Conducting the CT scan on site, allows the clinicians to review the images to make sure that the patient's exact desired areas of anatomy have been captured in the scan and to perform additional scans right then if adjustment is required for CT simulation. Currently, patients must go to the Hospital's main campus to receive their CT scan. As such, the radiation oncologist cannot conduct a real-time assessment of the scan results and provide input to make any necessary adjustments.

The current system where patients go to multiple locations for care is extremely inconvenient for patients and staff and is inconsistent with the standard practice of cancer treatment centers nationwide. Centers typically have a CT simulator onsite to perform treatment planning CT scans on patients. The addition of a CT simulator to the Bendheim Cancer Center will increase efficiency and streamline service by eliminating the need for oncology patients, many of whom are in a fragile state of health, to visit a separate location for their CT scans. By ensuring that patients receive their treatment planning scans under clinical conditions that most closely resemble the delivery of radiation therapy, the proposed CT simulator will also provide an enhanced standard of care. It will provide oncology patients with the most accurate, state-of-the-art technology and the highest possible quality of care.

B. Provide the Manufacturer, Model, Number of slices/tesla strength of the proposed scanner (as appropriate to each equipment).

The proposed scanner is a Phillips Brilliance CT Big Bore. It is a 16-slice helical whole body scanner optimized for Radiation Oncology CT simulation.

C. List each of the Applicant's sites and the imaging modalities and other services currently offered by location.

IMAGING SERVICES	GREENWICH HOSPITAL 5 Perryridge Road, Greenwich CT	GREENWICH HOSPITAL 2015 W. Main Street, Stamford Ct	GREENWICH HOSPITAL 77 Lafayette Place, Greenwich CT	GREENWICH HOSPITAL 55 Holly Hill Greenwich CT	GREENWICH HOSPITAL 75 Holly Hill Greenwich CT
General Radiography	X	X		X	X
Ultrasound	X	X	X		
CT	X	X			
Nuclear Medicine	X				
Mammography	X	X	X		
MRI	X	X			
PET/CT	X				
Bone Density		X			
Angiography	X				
Linear Accelerator			X		
RT Simulator			X		

Source: GH Imaging Department

D. Complete **Table 1** for each scanner (of the type proposed) currently operated by the Applicant at each of the Applicant's sites.

Table 1: Existing Scanners Operated by the Applicant

Provider Name Street Address Town, Zip Code	Description of Service *	Hours/Days of Operation **	Utilization ***

* Include equipment strength (e.g. slices, tesla strength), whether scanner is open or closed (for MRI)

Not applicable. Greenwich Hospital does not currently own a CT simulator.

E. Provide the following regarding the proposal's location:

i) The rationale for locating the proposed equipment at the proposed site;

To ensure comprehensive, coordinated care for Bendheim Cancer Center patients, Greenwich Hospital would like to purchase a CT simulator to support the new linear accelerator and facilitate the provision of radiation therapy treatment planning under more ideal clinical conditions than is currently possible. The Bendheim Cancer Center does not currently own a CT simulator. As a result, patients must go to the Greenwich Hospital main campus to receive their CT planning scans. The customary approach for cancer centers is for patients to receive their CT planning scan on a CT simulator in the same location, and by the same staff, where they receive their simulation and radiation therapy treatment. The purchase of a CT simulator will enable the Bendheim Cancer Center to conform to the industry's standard practice for imaging and treatment planning and will help provide enhanced care and seamless service to patients.

ii) The population to be served, including specific evidence such as incidence, prevalence, or other demographic data that demonstrates need;

	CT Service Area Male	CT Service Area Female	NY Service Area Male	NY Service Area Female
Population (#)				
2009	174825	183538	212194	230314
2014	176338	185019	216424	234179
Growth	1513	1481	4230	3865
Cancer Incidence (#)				
2009	1033	836	1225	1000
2014	1042	843	1250	1017

The population to be served by this proposal consists of Greenwich Hospital's oncology patients. Cancer is a leading cause of death both locally and nationally and will continue to grow in the future. The chart above shows projected population increases in the Greenwich Hospital service area towns as well as cancer incidence for these populations. The projected incidence rates are from the latest American Cancer Society publications and are based on state specific rates. A copy of *Cancer Facts and Figures 2010* by the American Cancer Society is included Exhibit 1 along with the detailed population projections.

iii) How and where the proposed patient population is currently being served;

It is anticipated that CT simulation services will be provided to patients historically served by Greenwich Hospital and Greenwich Hospital providers.

iv) All existing providers (name, address) of the proposed service in the towns listed above and in nearby towns;

Greenwich Hospital is not aware of any providers currently offering CT simulation services in the local area.

v) The effect of the proposal on existing providers; and

The addition of a CT simulator to Greenwich Hospital's Bendheim Cancer Center is not expected to impact local providers. It is anticipated that CT simulation services would be provided to patients historically served by Greenwich Hospital and Greenwich Hospital providers.

vi) If the proposal involves a new site of service, identify the service area towns and the basis for their selection.

Not applicable

2. Actual and Projected Volume

A. Complete the following tables for the past three fiscal years ("FY"), current fiscal year ("CFY"), and first three projected FYs of the proposal, for each of the Applicant's existing and proposed scanners (of the type proposed, at the proposed location only). In Table 2a, report the units of service by scanner, and in Table 2b, report the units of service by type of scan (e.g. if specializing in orthopedic, neurosurgery, or if there are scans that can be performed on the proposed scanner that the Applicant is unable to perform on its existing scanners).

Table 2a: Historical, Current, and Projected Volume, by Scanner

	Actual Volume (Last 3 Completed FYs)			CFY Volume*	Projected Volume (First 3 Full Operational FYs)**		
	FY ****	FY ****	FY ****	FY ****	FY ****	FY ****	FY ****
Scanner***							
Total							

* For periods greater than 6 months, report annualized volume, identifying the number of actual months covered and the method of annualizing. For periods less than six months, report actual volume and identify the period covered.
** If the first year of the proposal is only a partial year, provide the first partial year and then the first three full FYs. Add columns as necessary.
*** Identify each scanner separately and add lines as necessary. Also break out inpatient/outpatient/ED volumes if applicable.
**** Fill in years. In a footnote, identify the period covered by the Applicant's FY (e.g. July 1-June 30, calendar year, etc.).

Table 2b: Historical, Current, and Projected Volume, by Type of Scan

	Actual Volume (Last 3 Completed FYs)			CFY Volume*	Projected Volume (First 3 Full Operational FYs)**		
	FY ****	FY ****	FY ****	FY ****	FY ****	FY ****	FY ****
Service type***							
Total							

* For periods greater than 6 months, report annualized volume, identifying the number of actual months covered and the method of annualizing. For periods less than six months, report actual volume and identify the period covered.
** If the first year of the proposal is only a partial year, provide the first partial year and then the first three full FYs. Add columns as necessary.
*** Identify each type of scan (e.g. orthopedic, neurosurgery or if there are scans that can be performed on the proposed scanner that the Applicant is unable to perform on its existing scanners) and add lines as necessary.
**** Fill in years. In a footnote, identify the period covered by the Applicant's FY (e.g. July 1-June 30, calendar year, etc.).

SERVICE DESCRIPTION	FY06	FY07	FY08	FY09	FY10 Projected	FY11 Projected
CT SCANS	154	202	212	137	112	114
SIMULATIONS (PREPARATIONS AND VERIFICATIONS)	700	885	775	590	448	457
TOTAL	854	1,087	987	727	560	571

SERVICE DESCRIPTION	Year 1 FY12 Projected	Year 2 FY13 Projected	Year 3 FY14 Projected
CT SCANS	159	162	165
SIMULATIONS (PREPARATIONS AND VERIFICATIONS)	466	475	485
TOTAL	625	638	650

Source: GH Information Systems

Greenwich Hospital does not currently have a CT simulator. Therefore, historical volumes for simulations at the Bendheim Cancer Center and CT scans related to radiation therapy at the Greenwich Hospital main campus have been provided. This most accurately reflect the volumes that will be improved by the addition of a CT simulator at the Bendheim Cancer Center.

B. Provide a breakdown, by town, of the volumes provided in Table 2a for the most recently completed full FY.

Please see Exhibit 2 for a breakdown by town of FY09 volume, the most recently completed full fiscal year.

C. Explain any increases and/or decreases in volume seen in the tables above.

Greenwich Hospital has experienced declines in volume from FY07 to present. This is attributed to several causes. One, until recently the Bendheim Cancer Center had an older linear accelerator and was not providing state of the art technology to patients. This had a negative impact on referrals to the center. In addition, the former clinical director of the Bendheim Cancer Center opened a competing facility in nearby Westchester County on October 2007. Physician referrals moved over to the competing facility while Greenwich Hospital was in a transition phase and seeking a strong new director. As a result, volume at the Bendheim Cancer Center declined.

However, this decline is not projected to continue in future years. A new linear accelerator is now in operation at the Bendheim Cancer Center. Greenwich Hospital, as a member of Yale New Haven Health System, has a close relationship with the Smilow Cancer Hospital at Yale-New Haven and has strengthened this alignment over the past fiscal year. In July 2010, a new clinical director began at the Bendheim Cancer Center. All of these factors

combine to generate future growth at the Bendheim Cancer Center in addition to the growth in demand expected from an aging population and increased patients seeking cancer care as described previously in this document.

D. Provide a detailed explanation of all assumptions used in the derivation/ calculation of the projected volume by scanner and scan type.

Currently, patients seeking radiation therapy at Greenwich Hospital must go through a multi-step process at multiple facilities. First, the patient undergoes a simulation on the Bendheim Cancer Center's simulator for radiation therapy preparation. This involves Bendheim Cancer Center staff and physicians. After that, the patient must go at a later time over to the Greenwich Hospital main campus for a CT scan on the Hospital's CT scanner to assist in radiation therapy treatment plan development. Later, the patient must undergo a verification simulation back at the Bendheim Cancer Center. This multi-step process at multiple facilities is cumbersome and tiring for already fragile patients and is not the most efficient care that can be provided. In the charts above, historical volumes for full years each of FY06 through FY09 are listed. FY10 is eleven months of actual data (October 2009 through August 2010), flat line projected to estimate the full year volume.

With the addition of the proposed CT simulator at the Bendheim Cancer Center, the delivery of care would be improved and more efficient, more convenient for patients. Both preparations and CT scans can be provided at the same location, often within minutes of each other. Not only is this physically easier and more convenient for patients, it is also more efficient. While the patient is receiving the CT scan to assist in radiation therapy treatment planning, the radiation oncologist and other members of the treatment team would be onsite for the process. This allows them to review the images to make sure that the patient's exact desired areas of anatomy have been captured in the scan and to make any needed adjustments. It is projected that patients will receive all needed services within the Bendheim Cancer Center. The CT simulator will be used only for oncology care and will not be used for general diagnostic purposes.

As discussed above, it is anticipated that volume at Greenwich Hospital will increase slightly in the future. This is based on the aging of the population, the projected increase in patients requiring radiation therapy and changes to Greenwich Hospital's program at the Bendheim Cancer Center. To be conservative, a modest 2% annual growth rate was used to project future volume. FY 11 is a transitional year where the CT simulator will be installed and become operational at some point during the year. In FY12, it is expected that there will be forty three new CT scans in addition to the 2% growth. With the availability of the CT simulator at the Bendheim Cancer

Center, the center will follow national norms/industry best practices and have all patients receive a CT scan and a simulation. This was not done historically for a small number of patients but will be done in the future. The first three full years of operation are listed in the charts above for FY12, FY13 and FY14. Each of those years shows the 2% growth rate. All care would be provided at the Bendheim Cancer Center.

E. Provide a copy of any articles, studies, or reports that support the need to acquire the proposed scanner, along with a brief explanation regarding the relevance of the selected articles.

Please see Exhibit 3 for several articles that address the importance of the acquisition of the proposed CT simulator.

3. Quality Measures

A. Submit a list of all key professional, administrative, clinical, and direct service personnel related to the proposal. Attach a copy of their Curriculum Vitae.

Please see Exhibit 4

B. Explain how this proposal contributes to the quality of health care delivery in the region.

This proposal will have a positive impact on the quality of health care delivery in the region. There will be improvement in the clinical information that is obtained through the treatment planning scan by performing the scan on a CT simulator instead of a diagnostic CT scanner. Having a CT simulator onsite will allow the radiation oncologist and other staff to be present during the scan and request any real-time adjustments to the scan to be sure the most appropriate results are achieved and all the relevant portions of the patient's anatomy are captured. It will also ensure that the CT simulation scan is performed on the same type of table and equipment on which the patient will be treated so that consistent positioning and immobilization of the patients are achieved. By allowing the radiation oncologist and his/her team to better reproduce the patient's treatment position during the CT scan, the addition of a CT simulator will ensure that the highest quality care is being provided to patients. In addition, patients will be able to receive their care in one location and given the frail nature of the majority of patients, this will increase quality and continuity of care.

C. Describe the impact of the proposal on the interests of consumers of health care services and the payers of such services.

This proposal will increase efficiency by allowing oncology patients to receive their CT simulation scans in the same location, and by the same staff, as they receive radiation therapy treatments. The addition of a CT simulator will eliminate the need for patients, many of whom are in a fragile state of health, to visit a separate location for their CT simulation scans. Payers will not be impacted by this proposal as it is mainly a shift in location within Greenwich Hospital.

4. Organizational and Financial Information

a. Identify the Applicant's ownership type(s) (e.g. Corporation, PC, LLC, etc.).

Greenwich Hospital is a corporation.

b. Does the Applicant have non-profit status?
☒ Yes (Provide documentation) ☐ No

Please see Exhibit 5

c. Provide a copy of the State of Connecticut, Department of Public Health license(s) currently held by the Applicant and indicate any additional licensure categories being sought in relation to the proposal.

Please see Exhibit 6

d. Financial Statements

i) If the Applicant is a Connecticut hospital: Pursuant to Section 19a-644, C.G.S., each hospital licensed by the Department of Public Health is required to file with OHCA copies of the hospital's audited financial statements. If the hospital has filed its most recently completed fiscal year audited financial statements, the hospital may reference that filing for this proposal.

Greenwich Hospital's most recent audited financial statements (FY2009) are on file with OHCA.

ii) If the Applicant is not a Connecticut hospital (other health care facilities): Audited financial statements for the most recently completed fiscal year. If audited financial statements do not exist, in lieu of audited financial statements, provide other financial documentation (e.g. unaudited balance sheet, statement of operations, tax return, or other set of books.)

Not applicable

e. Submit a final version of all capital expenditures/costs as follows:

Table 3: Proposed Capital Expenditures/Costs

Medical Equipment Purchase	**$1,248,301**
Imaging Equipment Purchase	
Non-Medical Equipment Purchase	
Land/Building Purchase *	
Construction/Renovation **	**$71,900**
Other Non-Construction (Specify)	
Total Capital Expenditure	**$1,320,201**
Medical Equipment Lease (Fair Market Value) ***	
Imaging Equipment Lease (Fair Market Value) ***	
Non-Medical Equipment Lease (Fair Market Value) ***	
Fair Market Value of Space ***	
Total Capital Cost	**$1,320,201**
Capitalized Financing Costs (Informational Purpose Only)	
Total Capital Expenditure with Cap. Fin. Costs	**$1,320,201**

* If the proposal involves a land/building purchase, attach a real estate property appraisal including the amount; the useful life of the building; and a schedule of depreciation.
** If the proposal involves construction/renovations, attach a description of the proposed building work, including the gross square feet; existing and proposed floor plans; commencement date for the construction /renovation; completion date of the construction/renovation; and commencement of operations date.
*** If the proposal involves a capital or operating equipment lease and/or purchase, attach a vendor quote or invoice; schedule of depreciation; useful life of the equipment; and anticipated residual value at the end of the lease or loan term.

Greenwich Hospital has decided to purchase a different CT simulator than the one listed in the Letter of Intent. The proposed scanner is a Phillips Brilliance CT Big Bore. It is a 16-slice helical whole body scanner optimized for Radiation Oncology CT simulation. This has changed the cost of the project. Revised costs are listed above and on the front cover of the application. A quote is attached as Exhibit 7.

f. List all funding or financing sources for the proposal and the dollar amount of each. Provide applicable details such as interest rate; term; monthly payment; pledges received to date; letter of interest or approval from a lending institution.

The project will be funded by applicant's equity.

5. Patient Population Projections

a. Provide the current and projected patient population mix (based on the number of patients, not on revenue) with the CON proposal for the proposed.

Table 4: Patient Population Mix

	Current FY10	Year 1 FY12	Year 2 FY13	Year 3 FY14
Medicare*	44.23%	44.23%	44.23%	44.23%
Medicaid*	0.64%	0.64%	0.64%	0.64%
CHAMPUS & TriCare	0%	0%	0%	0%
Total Government	**44.87%**	**44.87%**	**44.87%**	**44.87%**
Commercial Insurers*	53.85%	53.85%	53.85%	53.85%
Uninsured	1.28%	1.28%	1.28%	1.28%
Workers Compensation	0%	0%	0%	0%
Total Non-Government	**55.13%**	**55.13%**	**55.13%**	**55.13%**
Total Payer Mix	**100.00%**	**100.00%**	**100.00%**	**100.00%**

* Includes managed care activity.
** New programs may leave the "current" column blank.
*** Fill in years. Ensure the period covered by this table corresponds to the period covered in the projections provided.

b. Provide the basis for/assumptions used to project the patient population mix.

It is anticipated that CT simulation services would be provided to patients historically served by Greenwich Hospital and Greenwich Hospital providers. Therefore, the patient population mix is comprised of patients seen during the current fiscal year.

6. Financial Attachments I & II

a. Provide a summary of revenue, expense, and volume statistics, without the CON project, incremental to the CON project, and with the CON project. **Complete Financial Attachment I.** (Note that the actual results for the fiscal year reported in the first column must agree with the Applicant's audited financial statements.) The projections must include the first three full fiscal years of the project.

Please see Exhibit 8

b. Provide a three year projection of incremental revenue, expense, and volume statistics attributable to the proposal by payer. **Complete Financial Attachment II.** The projections must include the first three full fiscal years of the project.

Please see Exhibit 9

c. Provide the assumptions utilized in developing **both Financial Attachments I and II** (e.g., full-time equivalents, volume statistics, other expenses, revenue and expense % increases, project commencement of operation date, etc.).

Please see Exhibit 10

d. Provide documentation or the basis to support the proposed rates for each of the FYs as reported in Financial Attachment II. Provide a copy of the rate schedule for the proposed service(s).

Please see the information contained in Exhibit 10

e. Provide the minimum number of units required to show an incremental gain from operations for each fiscal year.

Assuming the current payer mix, approximately 264 units would be required to breakeven. There is no additional Medicare reimbursement for this service as it is bundled in the current radiation treatments. This proposal is about increasing the quality of patient care.

f. Explain any projected incremental losses from operations contained in the financial projections that result from the implementation and operation of the CON proposal.

As discussed previously, this proposal will have a quality impact on patient care. There are no additional resources required and the only expense is related to the depreciation and service contract on the machine.

g. Describe how this proposal is cost effective.

This proposal will increase efficiency by allowing oncology patients to receive their CT scans in the same location, and by the same staff, as they receive simulations. The addition of a CT simulator will eliminate the need for patients, many of whom are in a fragile state of health, to visit a separate location for their CT scans. Payers will not have to pay for repeat scans if the first treatment planning CT scan is not accurate. The onsite CT simulator will allow the radiation oncologist to confirm the accuracy of the image the first time.

7. Other Review Criteria

A. Describe the proposal's relationship to the Applicant's long-range plans. Provide supporting documentation.

Greenwich Hospital's long range plans focus on providing needed care and services to patients, families and members of the community. Key factors are the provision of high quality, easily accessible and cost efficient care. As discussed throughout the application, the CT simulator will allow the Hospital to give needed care in the best location for patients. Having a CT simulator in the Bendheim Cancer Center will enable Greenwich Hospital to

provide high quality care in the most accessible location for patients and an efficient manner.

B. Specify whether any of the following apply to the proposal. If so, provide an explanation and supporting documentation.

i) Voluntary efforts to improve productivity and contain costs

This proposal improves productivity by eliminating the need for patients to visit two separate locations in order to receive their CT planning scans and radiation treatment simulation and planning. Patients will receive all the needed clinical components to complete their treatment planning at one location, namely the Bendheim Cancer Center. In addition, under the current arrangement, patients must occasionally obtain a second CT scan for simulation purposes in instances when all of the required clinical information has not been captured during the first scan. Because physicians will be on site during the scan to ensure that all necessary anatomical detail has been captured, patients will no longer be required to make a second visit for an additional scan. This will reduce costs to both the patient and the health care system.

ii) Changes to the Applicant's teaching or research responsibilities; and/or

This proposal does not result in any changes to Greenwich Hospital's teaching or research responsibilities.

iii) Special characteristics of the Applicant's patient or physician mix.

There are no special characteristics of Greenwich Hospital's patient or physician mix.

000016 NOV 1 10

HOSPITAL AFFIDAVIT

Applicant: Greenwich Hospital

Project Title: Acquisition of a CT Simulator

I, Frank A. Corvino, President/CEO of Greenwich Hospital, being duly sworn, depose and state that the (Hospital Name) information submitted in this Certificate of Need application is accurate and correct to the best of my knowledge. With respect to the financial impact related to this CON application, I hereby affirm that:

1. The proposal will have a capital expenditure in excess of $15,000,000.

   ☐ Yes ☒ No

2. The combined total expenses for the proposal's first three years of operation will exceed one percent of the actual operating expenses of the Hospital for the most recently completed fiscal year as filed with the Office of Health Care Access.

   ☐ Yes ☒ No

Signature

October 8, 2010
Date

Subscribed and sworn to before me on October 8, 2010

Notary Public/Commissioner of Superior Court

My commission expires: SHEILA G. VENTO NOTARY PUBLIC MY COMMISSION EXPIRES MAR. 31, 2012

000017 NOV 1 10

GREENWICH HOSPITAL
YALE NEW HAVEN HEALTH

October 14, 2010

Greenwich Time
1455 E. Putnam Ave.
Old Greenwich, CT, 06870
Attn. Saran 203-333-0161 ext. 208
Legal.notices@scni.com

Dear Saran:

Please make an insertion of the copy below, in a single column space, set solid under legal notices, in the *Greenwich Times Newspaper* by no later than October 16, 2010. Please run the insertion for three consecutive days.

Please provide the following within 5 days of publication:

- Proof of publication (copy of legal advertisement acceptable) showing published date along with the invoice.

If there are any questions regarding this legal notice, please call me at (203) 863-3909. I would appreciate if you would call me and let me know the cost for the legal notice. Thank you in advance.

PLEASE INSERT THE FOLLOWING:
Statute Reference: 19a-639
Applicant: Greenwich Hospital
Town: Greenwich
Street Address: 5 Perryridge Road
Docket Number: 10-31647-CON
Description: The applicant is seeking approval from the Office of Health Care Access for the acquisition of a CT Simulator.

Sincerely,

Nancy M. Hamson

Nancy M. Hamson
Director of Planning
Planning Department
Greenwich Hospital
5 Perryridge Road
Greenwich, CT 06830
Phone: 203-863-3909
Fax: 203-863-4784
Email: nancy.hamson@greenwichhospital.org.

Saturday 10/16/10

000018 NOV 1 10

Greenwich Time in partnership with Yahoo! hotjobs

Classified

877-542-6052

FAX: 203-384-1158 EMAIL: classified@scni.com

MAJOR CREDIT CARDS ACCEPTED

EMPLOYMENT

General Help Wanted

ASSOCIATE EDITOR

Associate Editor for CT Hearst Media Services: A growing magazine division.

Candidate should have 3-5 years print experience, and be an accomplished writer, editor and copy editor. Must be able to travel regularly to Albany, NY area.

E-mail resume and clips to reynolds@timesunion.com

Associate Rep **RAPID EXPANSION** $16 base/appt. Local company has 35+ openings in customer sales/svc, Flex sched, PT/FT. Will Train, all ages 17+, cond. apply Call NOW! 203-210-7648.

AUTO BODY PERSON for busy New Canaan Body Shop. Must have own tools & transp. Call 203-966-2028

AUTO MECHANIC Must have exp., own tools, speak English. Pay based on exp. & performance. Apply in person: 16 Long Ridge Rd, Stamford.

AUTO TECHNICIAN Highly professional

General Help Wanted

EDUCATION REPORTER

Greenwich Time, a 10,000-circulation daily in Greenwich, Conn., seeks an experienced education reporter to cover Greenwich Public Schools and the town's several private schools, a high-profile beat that is closely watched by the readership.

We are looking for an aggressive reporter who will dig deeper than what is presented at the Board of Education meetings and develop relationships with key stakeholders to produce solid enterprise. In recent years, the district has struggled with declining standardized test scores that have hurt its image as one of the state's finest school districts. We have examined district conditions and its obstacles to improvement and have compiled test score data to compare Greenwich public schools to other state districts.

This position will spearhead this coverage of the issues, as well as get inside the classroom to tell evocative stories about the experiences of students, teachers, parents and

General Help Wanted

LIC'D CLINICIAN FT for outpatient mental health clinic, Bpt. Diagnostic assessment & treatment planning & group work exp. Send resume: rmadwid@ccfc-ct.org

Managing/Sports Editor

The Norwalk Citizen News, a Hearst-owned weekly newspaper, is seeking a Managing/Sports Editor.

The job entails covering high school and youth sports, attending games, writing feature stories about athletes and sports personalities, and designing the sports section once a week.

The job also entails work on the news side of the paper by helping design pages in the news section, pitching story ideas, writing some news stories and editing articles.

The applicant will also write stories that appear in sister daily papers The Stamford Advocate and the Connecticut Post. Experience with InDesign is a plus, as is designing pages on a tight deadline. Photography skills may be necessary from time-to-time, and a reasonable means of travel is

General Help Wanted

Research **DO YOU DRINK ALCOHOL NEARLY EVERYDAY?** If you are 21-50 yrs old, you may be eligible to participate in a Yale research study involving a ONE-night stay in the research unit at Yale New Haven Hospital. This is not a treatment study. You can earn up to $726. All calls are confidential. Call Nick (203) 974-7679. HIC #0602001068.

RESTAURANT Complete staff needed. Exp only! All shifts. Call 203-668-5229 or apply Tonellis's 41 Grassy Plain St in Bethel.

SALES ASSOCIATE Upscale womens retail store in White Plains, needs a highly professional person w/exp. in sales of top designer fashions. Email resume to mjdenzer@gmail.com

SALES/MARKETING ASSISTANT Assist salesmen with sales detail work. Corporate design exp pref. Fax resume to 203-975-1377.

Sales **TELEPHONE SALES- PT** Evenings Exp Helpful Call; 203-778-9979

VETERINARY ASSISTANT FT, starting at $12/hr. Prior animal exp. req'd. Health insurance avail. Send resume to or apply in person at Community Vet Clinic, 136 Fairfield Woods Rd, Ffld. 203-372-2436

WAREHOUSE OPPORTUNITIES

Situations Wanted

ATTENTION The advertisers in this classification are providing a service.

CAREGIVER willing to provide to elderly the care that they need at an affordable rate. Reliable, own car. 10years exp. Avl. now. 203-559-5490

CARPENTER/ CABINETMAKER w/20 yrs exp. looking for work. Specializing in custom made cabinets & cabinet refacing, kitchen counter tops & bathroom vanity. Affordable rates, will work w/ your budget. Call 203-396-0496.

CERTIFIED NURSES Aide available for FT work. Experience in elder care. Refs available. Own car. Affordable rates!! Roselyn 203-455-7552.

CNA IS LOOKING FOR a Companion or Home Care Aid position. Experienced, reliable. 203-434-2160

DEPENDABLE, professional and reliable female seeks Nanny and/or Housekeeping position. Please call 203-246-4010.

ELDERLY caregiver European lady is looking for companion aide position. Live in. Good refs. LOW RATES Call 203-570-3252.

EXPERIENCED HOUSECLEANER Many years exp. good refs, own trans. Days & weekends. 203-371-2954 or 203-

Situations Wanted

POLISH WOMAN seeking a housecleaning position. Exp'd, references, speaks English, drives. 203-353-8718

RESPONSIBLE NICE reliable lady seeks position. Housecleaning, exc. ironing, errands. Legal, Exc refs & English. Own trans. 203-609-0632

SPANISH OR ITALIAN SPEAKING ladies, looking for job as companion/ nanny or housekeeper. FT/PT. Good refs 203-559-2175.

YOUNG UKRAINE lady looking for houses to clean. Excl. refs. Exp. You'll Love Coming Home To A Clean House. Oxenia 203-588-9879

BUSINESS OPPORTUNITIES

Business / Investment Opportunities

REST/NIGHT CLUB Blk Rck/Bpt area. 180+ occ. Full kitch & liq lic. 203-373-9136. Serious Operators. $349,999.

STAMFORD STORE FOR RENT Well known area. 25yr old Grocery Store. 131 Cove Rd. 2500sf incldg bsmnt. 203-650-1532 for info

ANNOUNCEMENTS

Novenas

Prayer To The Blessed Virgin (Never Known to Fail) Oh, most beautiful flower of Mt. Carmel. Fruitful vine, splendor of Heaven, Blessed Mother of the Son of God, Immaculate Virgin, assist me in my necessity. O Star of the Sea, help me and show me, here You are my Mother Oh, Holy Mary, Mother of God, Queen of Heaven and Earth, I humbly beseech you from

Merchandise for Sale

2010 TICKET FOR ANY SIX FLAGS 2010 Six Flags entrance ticket worth $59.99 sell for $29.99. Pickup or I'll mail it. Credit Card OK. Margaret 203-536-9770

25ft Aluminum Extension Ladder Like New American Made 203-722-4948 cycleman@optonline.net $150

2 CONTEMPORARY OFFICE OR STUDIO UPLIGHT PENDANT FIXTURES from The American Glass Light Company. This Dexter series Uplight (catalog #2536-U) was replaced due to office redesign. height is 20". It has a 24" square frosted glass pendant, a satin aluminum finish base & extention and requires 26 watt bulbs. great condition and each pendant costs $550 each negotiable

4 Month Old Dishwasher. Nearly new, used very little, redid kitchen. 9 cycles including upper rack separate cycle. Excellent built in . $350.00 203-322-1402

7-UP SHELF 4 Foot Standing 7-Up Shelf Clear Square Tubes With Crate Type Shelves, Good Condition! Green & Clear In color. $40.00 203-981-5913

AMBIANCE LIGHTING SYSTEMS This track lighting fixture can be used for a residential home and used specifically for directional lighting. The brand is Sea Gull Lighting. The package will include 3 directional light fixtures, the track, and 2 sets of stems on either end. The owner has also has bought a brand new, unused transformer from WAC Lighting to go along with the item. $500. 203-862-0412

BABY CRIB Babi Italia, natural wood color, drawer for storage underneath mattress spring, excellent condition, $25.00. Call 203-869-9071.

BABY SPOONS Early 1900's Era Vintage Pewter Baby Spoons 1 Mickey Mouse, 1 Plain With Design With Turned In Loop Handles. Good Old Condition! Asking $50 For Both. 203-981-5913

Merchandise for Sale

BOYS BICYCLE Kent, Age Group 5-8 Years Old. Red & Yellow, Hand & Pedal Brakes. $50. 203-981-5913

BOY'S SNOWSUIT Perfect condition Mighty Mac boy's snowsuit in size 12 mo. Beautiful blue color with sweet little designs, booties and mits included. Absolutely adorable. Only $10. 203-329-8456.

BUNK BEDS light maple with built in desk and dresser all in one unit also bottom bunk has shelving for clock radio etc each bed is twin sized $250. 203-273-4954

CABINETS (2) BLACK, GLASS FRONT DOORS, ONE SHELF, GREAT FOR TELEVISIONS, BOOKS, STEREO EQUIPMENT, END TABLES, ETC, 26"L x 19.5"D x22.5"H $50. 203-637-1216

CARGO CARRIER Sears Cargo Carrier, All hardware and straps included. Fits on top of your car or van. Heavy Duty Plastic. $50. Please call 203-761-0427

CASSETTE TAPES 75 Misc. Cassette Music Tapes Rock-, Blues, Jazz, Classical, Movie Soundtracks. All In Good Condition! $50.00 For All! 203-981-5913

CAST IRON KEYS 2 Black In Color, 7" Long Each, Have Markings On Them & #41. Great Cond. $25.00 For Both! 203-981-5913

CAT CARRIER Medium Sized All Hard Plastic, Metal Locking Door! Brand New Cond! Asking $25. 203-981-5913

CEILING FAN New in Box! 42" almond with polished brass with 3 light set. pd $68 asking $40 email me for. email me for picture cycleman@optonline.net. 203-722-4948

CEILING FAN New in Box! 42" almond with polished brass with 3 light set. pd $68 asking $45 email me for picture cyclecyman@optonline.net. 203-722-4948 $40.00

CELLO Beginner size Like New. NO SCRATCHES. it could be sold as new. Comes with Bow and soft carrying case

Public Notices

LEGAL NOTICE
Statute Reference: 19a-639
Applicant: Greenwich Hospital
Town: Greenwich
Street Address: 5 Perryridge Road
Docket Number: 10-31647-CON
Description: The applicant is seeking approval from the Office of Health Care Access for the acquisition of a CT Simulator.

Public Notice

Notice is hereby given that the Town of Greenwich has revised Chapter 9 of the Town Code dealing with Refuse, Garbage, Waste Collection, Disposal and Litter. Violation of the Waste Collection and Disposal provisions of the ordinance including prohibited delivery of out-of-town waste to the Town transfer station now carried fines of up to $1,000. In particular a new section has been added as follows to:

Article 1 Waste Collection and Disposal

Sec. 9-11.1. Penalty; appeal; hearing

(a) Violation of the provisions of this article affecting the delivery of waste to the town disposal area or such other place as directed by the Superintendent shall be subject to civil penalty fines of up to one hundred dollars ($100) for a first violation, two hundred fifty dollars ($250) for a second violation and one thousand dollars ($1,000) for each subsequent violation. The Superintendant may impose such fines on the transporter if the waste in violation is more than one (1) cubic foot in volume and it exceeds five percent (5%) of the load transported. Fines for the first two discoveries of violation may be avoided in the first instance by the transporter remedying the violation by delivering the waste to the disposal place designated by the Superintendent and in the second instance by the transporter paying the disposal fee or charge incurred by the town and providing a written report satisfactory to the Superintendent of the cause of the violation including, if pertinent, the source of the generation of the waste and what corrective measures are being followed. Upon completion of such corrective measures the Superintendent shall clear the record of violations of the transporter. If the transporter is not the generator of such waste and the violation is determined by the Superintendent to be the fault of the generator the Superintendent may impose such fines on the generator.

(b) Civil penalty fines under part (a) of this section shall be payable to the town and may be appealed within ten days to the Commissioner who shall conduct a hearing and render a decision thereon. Any fine determined by the Commissioner in excess of one thousand dollars ($1,000) may be appealed within ten days to the Board of Selectmen which shall designate a hearing officer, not employed by the Department of Public Works, to conduct a hearing and make a recommendation to the Board which shall make a decision on such recommendation.

(c) Any other violation of the provisions this article shall be subject to a fine of up to two hundred fifty dollars ($250).

Other sections of the Waste Collection and Disposal Article have been amended concerning the proper disposal of bulky waste and hazardous waste in accordance with directives of the Superintendent and applicable state and federal law.

In addition Article 2 Litter, has been amended to prohibit hazardous accumulations of yard waste constituting landscape debris which are defined in Section 9-12(a)(4) and (10) as follows:

The ADVOCATE Greenwich Time

Classified

Stamford: 877-542-5620
Greenwich: 877-542-6052
FAX: 203-384-1158 EMAIL: classified@scni.com
MAJOR CREDIT CARDS ACCEPTED

in partnership with YAHOO! hotjobs and SouthernCTjobs.com

Public Notices

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EMPLOYMENT

People Seeking Employment

AFTER 3 YEARS OF TAKING CARE OF our Mom, the caregiver is looking for a job. Caring, honest, reliable. Her number is 203-661-3409. For references call 914-939-2011

Situations Wanted

1A Cleaning Lady 6 day work. 15 yrs exp. Exc. ref. Own transp. Insured. Call 203-912-1469

1or 2 women seeking houses, apts, and offices to clean. References available. Call 203-524-5778, or 203-324-6873.

2 LADIES seeking house cleaning positions. Shampoo carpets, good refs.

Situations Wanted

FALL DISCOUNTS
Professional tree service-Maintenance. Specializes pruning, take down, cabling, removals. Call for free estimates & storm prevention. Dough 914-260-2335 or email: Hansvanzutphen@gmail.com

HOUSECLEANING
2 sisters looking for a job. We have over 14 years experience. Refs avail, own transportation. Call 203-943-6559

HOUSEKEEPER
Clean all, including floors & carpet + laundry. Good refs. & prices. 203-561-7663; 203-299-0386

HOUSECLEANING
Light cooking, experienced & exc refs. Seeks job day to day, PT/FT. Please call 914-439-1151; 914-437-8636

HOUSEKEEPER
Available part time, Tues-Fri, from 1-6pm. References, has own transportation, is reliable & legal. 15 years exp. Call 914-357-0055; 914-683-6270

HOUSEKEEPER/ Nan-

Lost & Found

HAVE YOU SEEN FIFI ? Lost in the area of Queens Lane in Darien on Saturday 2nd October. She is a brownish grey tabby CaT with white nose and cheeks, white belly and paws. If you think you have seen her PLEASE take the time to call Alina 917 251 1517. or the Darien animal control officer at 203 655 8686.

Fi Fi is very shy and much missed by her family.

LOST: White long hair Blue point Birman cat. 10/8, vicinity Ferris Drive, Old Greenwich. Reward for info and/or return. 203-637-2250

MERCHANDISE FOR SALE

Heating & Firewood

CENTRAL BOILER
E-Classic OUTDOOR FURNACES. Heat your entire home and hot water. EPA Qualified. Up to 92% Efficient. Call Today and save up $3500 203-263-2123

GUARANTEED SEASONED FIREWOOD
$230/cord delivered. Call 203-247-2505.

Merchandise for Sale

BABY SPOONS
Early 1900's Era Vintage Pewter Baby Spoons 1 Mickey Mouse, 1 Plain With Design With Turned In Loop Handles. Good Old Condition! Asking $50 For Both. 203-981-5913

BANQUET TABLE
STURDY, FOLDS IN HALF FOR EASY COMPACT STORAGE. SEATS 8 PEOPLE. STILL IN BOX. 30" X 72" $50.00 CALL 203-550-7047

BANQUET TABLE
STURDY, FOLDS IN HALF FOR EASY COMPACT STORAGE, W/FOLDING LEGS, SEATS 8 PEOPLE, STILL IN BOX. 30" X 72". $50.00 CALL 203-550-7047

BARBIE DOLLS
four 1966 Era Barbie Dolls No Boxes! All In Good Condition With Clothing, Asking $60. 203-981-5913

BASKETBALL CARDS
30 Old School Basketball Cards 1990's Era NBA Hoops, Topps Cards, Scottie Pippin, Bird, Ewing, Johnson, Etc... All In Good Condition! $30.00 203-981-5913

BASKETBALL/ WARM UP PANTS
Unisex in various colors BRAND NEW. Sizes Youth Sm, Youth Med. and Yourth Large. Super Low Price of $7.00 a pair or 2 pair for $12.00! 203-496-0130

BATHTUB

Merchandise for Sale

CARGO CARRIER
Sears Cargo Carrier, All hardware and straps included. Fits on top of your car or van. Heavy Duty Plastic. $50. Please call 203-761-0427

CASSETTE TAPES
75 Misc. Cassette Music Tapes Rock-, Blues, Jazz, Classical, Movie Soundtracks. All In Good Condition! $50.00 For All! 203-981-5913

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2 Black In Color, 7" Long Each, Have Markings On Them & #41. Great Cond. $25.00 For Both! 203-981-5913

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Medium Sized All Hard Plastic, Metal Locking Door! Brand New Cond! Asking $25. 203-981-5913

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New in Box! 42" almond with polished brass with 3 light set. pd $68 asking $40 email me for. email me for picture cyclecyman@optonline.net. 203-722-4948

CEILING FAN
New in Box! 42" almond with polished brass with 3 light set. pd $68
asking $45 email me for picture
cyclecyman@optonline.net.
203-722-4948
$40.00

CELLO Beginner size Like New. NO SCRATCHES. it could be sold as new.

Merchandise for Sale

CHAIRS
Set Of 2 Wooden Chairs Brown & Black in Color, Very Good Condition! Asking $50. 203-981-5913

CHEST OF DRAWERS
5 drawers $25. call 203-249-7975

CHILDS LEARN & PLAY HARMONICA SET
By First Act Discovery, Includes Harmonica & Instructional Book. Great Condition! Perfect For The Beginner! $25.00 203-981-5913

CHILDRENS LEARN & PLAY HARMONICA SET
By First Act Discovery, Includes Harmonica & Instructional Book, Great Condition! $25.00 203-981-5913

CHINA CABINET
Large Blonde Color Wood With Glass Slider Doors On Top Part, Cabinets & Drawers Underneath! 65"High X 45"Wide,X 13"Deep. Great Condition! Very Well made! Very heavy! Paid Over $1,500! $150. 203-981-5913

CHRISTMAS CRAFTING SUPPLIES
Miscel Items, Greens, Lights, Wreaths, Ropes, Chains, Ornaments, Berries, Ribbons, Bows, Candles, Etc. Make Offer 203-323-6034

CLOSET ORGANIZING SYSTEM
Free Standing,

Merchandise for Sale

COLLECTIBLE NEW YEAR'S NUTCRACKER
from 2000 called Millineum Man. Very Detailed makes a great gift for the collector. $49.99. http://stores.ebay.com/divadeals for more info. 203-496-0130

COLLECTION Clear Glass Candle Shades & Chimneys, Small, Medium, Large Sizes in a Varity Styles & Shapes $2.00 Each 203-323-6034

COMIC CARDS
1990's Era Foil Hologram Collector Comic Cards In Plastic Cases, 2 Are Signed By The Author-Robot Fighter, Superman, Pitt, Spiderman, DC Comics & Marvel Masterpiece. Asking $75 For All!! All Are In Mint Condition!! *Call 203-981-5913

CONAIR FOOT SPA
Soothes & Massages Tired & Aching Feet, Very Relaxing $15 BO. 203- 323-6034

CONAIR COMFORT BELT MASSAGER
Brand New In Box. Portable, Battery Operated! $25.00 Call 203-981-5913

CONFERENCE TABLE
very good condition, strong, big enough to fit 10 people. Solid mahogany Double drum base 48; Width 120; Length 31 Height

Merchandise for Sale

COPPER COOKTOP HOOD
Thermador hammered copper vented hood for gas cooktop. 46"L by 28.5"W by 25"H, 2 lights, fan. Great looking, especially in country kitchen. $225. 203-869-0628

CORVETTE NOSE MASK
1977 cover-craft corvette mask with logo sells new for $135. exc condition hardly used our price $50. 203-315-5203

COUCH
Black leather 90" couch, mint cond, $499. 203-979-3558 Bill

COUCHES Jennifer Convertible Queen Sleeper and Love Seat, excellent condition. Slipcovers and pillows available. Both for $400 or will sell seperately. Cash and carry only. 203-554-0687

COUCH
purchased for $450 less than a year ago. beige fabric, 3 cushions and includes 3 multi-colored throw pillows. 89"L, 37"W and 40"H. Excellent condition and very comfortable! $225. Mike at 203-918-4698

CRAFTSMAN TABLE SAW
Saw with stand. Gently used. Carbide tipped blade. $200. Excelent condition. 203-355-0861

CREDENZA

Merchandise for Sale

DESIGNER HANDBAG
WOMENS COACH HANDBAG BRAND NEW. $175. CALL 203-550-7047

DIGITAL CAMERA
Sony DSC-T300 with Rechargeable Battery Pack, USB/AV cable, Full HD 1080, 10.1 Megapixes, 5x Optical Zoom, 3.5" Wide Screen. Like New. Hardly Used. $315. 203-968-1609

DRUM SET
with hardware and cymbals exc cond, $250. 203-866-4879

DRYER
Admiral electric dryer. 1 year old. $100. 203-661-6813.

DVD PLAYER
Great Working condition! $40. 203-981-5913

DVD'S & CD'S
Nice selection of DVD's, CD's, Children's Books and eight hardcover Nancy Drew collection ranging in price from $1 to $5. Please call 203-329-8456.

Merchandise for Sale

EARRINGS
2 Pair Sterling Silver With Turquoise Dangle Type, Brand New! $40. 203-981-5913

ELVIS PRESLEY MUSIC BOX
porcelain "68 Comeback Special" Issued By Ardleigh Elliott, 1992. Elvis Presley Music Box Collection! #541B, Plays Music Of "Heart Break Hotel" Mint Condition In Box. Has Crushed Red Velvet Interior! $100. Call 203-981-5913

EMPLOYEE TIME CLOCK
Widmer Model 175 Time Recorder/Employee Time Clock Electronic time stamp/Employee Time Clock Excellent condition, but probably needs a new ribbon. Was used a short time in an office. Currently quoted on the internet at $175..priced to sell at $50 cash/firm. 617-448-4912

Call Classifieds Today 203-327-7500

Greenwich Time

Classified

877-542-6052

FAX: 203-384-1158 EMAIL: classified@scni.com

MAJOR CREDIT CARDS ACCEPTED

In partnership with YAHOO! hotjobs and SouthernCTjobs.com

Public Notices

LEGAL NOTICE

CHIMEY COVE TAX DISTRICT

Proportionate share of tax levied at 0.000125 (mills) on the Grand List of September, 2010 by action of Chimney Cove Tax District at the September 5th, 2010 Annual Meeting. This tax is due and payable November 1st, 2010 in a single installment and becomes delinquent December 1st, 2010 at which time it "shall be subject to interest at the rate of one and one half (1 ½%) percent of such tax for each month or fraction thereof which elapses from the time when such tax becomes due and payable until the same is paid."

Please Note: We, the Chimney Cove Tax District, have no choice but to confirm with applicable section of the Conn. General Statutes, including Section 12-145 which is quoted, in part above.

LEGAL NOTICE

Pursuant to Section 303.86 of the regulations of the Federal Deposit Insurance Corporation (the "FDIC"), notice is hereby given that George F. D'Angelo of Sarasota, Florida and John J. Fareri of Greenwich, Connecticut, have submitted a Notice of Change in Control to the FDIC regarding their proposed acquisition of control of The First Bank of Greenwich, Cos Cob, Connecticut.

Any person wishing to comment on this Notice may file his or her comments, in writing, with the Regional Director of the FDIC, at 15 Braintree Hill Office Park, Suite 100, Braintree, MA 02184-8701, not later than November 8, 2010. The non-confidential portions of the Notice are on file at the appropriate FDIC office and are available for public inspection during regular business hours. Photocopies of the non-confidential portion of the Notice file will be made available upon request.

LEGAL NOTICE

Statute Reference: 19a-639
Applicant: Greenwich Hospital
Town: Greenwich
Street Address: 5 Perryridge Road
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CLASSIFIED INDEX

Probate Notices

REVISED NOTICE TO CREDITORS

ESTATE OF RUTH LEWIS

The Hon. David W. Hopper, Judge of the Court of Probate, District of Greenwich, by decree dated October 8, 2010 , ordered that all claims must be presented to the fiduciary at the address below. Failure to promptly present any such claim may result in the loss of rights to recover on such claim.

Vincenza Guarino,
Assistant Clerk

The fiduciary is:

Stewart Lewis,
c/o Christopher Barrato, Esquire,
2 Sherman Court,
Fairfield, CT 0682

Kenneth Lewis
c/o Christopher Barrato, Esquire,
2 Sherman Court,
Fairfield, CT 06824

REVISED NOTICE TO CREDITORS

ESTATE OF JENNIE CHIAPPETTA

The Hon. David W. Hopper, Judge of the Court of Probate, District of Greenwich, by decree dated October 5, 2010, ordered that all claims must be presented to the fiduciary at the address below. Failure to promptly present any such claim may result in the loss of

General Help Wanted

COUNTER/DRIVERS FT/PT. MUST be reliable. Apply in person. Giove's Pizza, 246 Post Road, Fairfield 203-254-3772

DELI HELP- PT/FT for Brookfield deli. Food prep, Cashier, Deli exp. & English speaking a must. Call 203-241-0023

DRIVERS / CHAUFFER
F/T - P/T must have PSL, clean drivers license. Suit & tie req'd & own cell. Call 203-223-3040 Press #1. Must speak English fluently, knowledge of all NY airports, NY City.
Limo experience a must!

DRIVERS TAXI/LIVERY MUST BE over 25 & have Public Service lic. Apply 65 Stillman Street, Bridgeport

EDUCATION REPORTER

Greenwich Time, a 10,000-circulation daily in Greenwich, Conn., seeks an experienced education reporter to cover Greenwich Public Schools and the town's several private schools, a high-profile beat that is closely watched by the readership.

We are looking for an aggressive reporter who will dig deeper than what is presented at the Board of Education meetings and develop relationships with key stakeholders to

General Help Wanted

LAW OFFICE Practice Administrator for busy general practice firm. Must have 5 yrs exp min & college degree. Multiple offices, 3 attorneys & 6 support staff. "PC Law" software exp pref'd. Duties incl file & calendar mgmt, billing & collections, and all other supervisory / mgmt tasks. EMAIL resume & cover letter to: LAWFAIRCT@gmail.com.

LIC'D CLINICIAN FT for outpatient mental health clinic, Bpt. Diagnostic assessment & treatment planning & group work exp. Send resume: rmadwid@ccfc-ct.org

Managing/Sports Editor

The Norwalk Citizen News, a Hearst-owned weekly newspaper, is seeking a Managing/Sports Editor.

The job entails covering high school and youth sports, attending games, writing feature stories about athletes and sports personalities, and designing the sports section once a week.

The job also entails work on the news side of the paper by helping design pages in the news section, pitching story ideas, writing some news stories and editing articles.

The applicant will also write stories that appear in sister daily papers. The

General Help Wanted

RECEPTIONIST
Exp'd individual with computer, scheduling & exc. communication skills for Greenwich Salon. Call 203-637-9154

RESTAURANT
- Servers,
- Busers &
- Bartenders

Exp. a plus. Apply in person: 378 Main St. Ridgefield or Email: Rmrdpt@aol.com

RESTAURANT
Complete staff needed. Exp only! All shifts. Call 203-668-5229 or apply Tonellis's 41 Grassy Plain St in Bethel.

SALES- CLOSER'S DREAM 7-9 conf. appts per week, 6-8 sales per month, ave. sale $27K, ave. comm. 7%. Fortune 500 Co., one of kind product w/ exclusive territory. Must have strong work ethic & good people skills. 1-3 yrs outside sales exp., call 800-800-6056

SALES ASSOCIATE
Upscale womens retail store in White Plains, needs a highly professional person w/exp. in sales of top designer fashions. Email resume to mjdenzer@gmail.com

SALES/MARKETING ASSISTANT
Assist salesmen with sales detail work. Corporate design exp pref. Fax resume to 203-975-1377.

SALES- REAL ESTATE
Stamford. Learn & earn. Full training. Get your lic. in 90 days. Chris 203-251-7535

VETERINARY ASSISTANT
FT, starting at $12/hr. Prior animal exp. req'd. Health insurance avail. Send resume to or apply in person at

Situations Wanted

1A Cleaning Lady 6 day work. 15 yrs exp. Exc. ref. Own transp. Insured. Call 203-912-1469

1or 2 women seeking houses, apts, and offices to clean. References available. Call 203-524-5778, or 203-324-6873.

ACTIVE Lady is looking for house cleaning job. Avail days Mon-Sat. Exc refs. Own transportation. 203-532-5197

ATTENTION
The advertisers in this classification are providing a service.

CAREGIVER willing to provide to elderly the care that they need at an affordable rate. Reliable, own car. 10years exp. Avl. now. 203-559-5490

CNA IS LOOKING FOR a Companion or Home Care Aid position. Experienced, reliable. 203-434-2160

ELDERLY caregiver European lady is looking for companion aide position. Live in. Good refs. LOW RATES Call 203-570-3252.

EXP woman seeking PT/FT Nanny position in New Canaan, Darien, Stamford & Norwalk area. Exc refs. Own transportation. Call 203-550-3499.

HOUSECLEANING 2 sisters looking for a job. We have over 14 years experience. Refs avail, own transportation. Call 203-943-6559.

Lost & Found

LOST: White long hair Blue point Birman cat. 10/8, vicinity Ferris Drive, Old Greenwich. Reward for info and/or return. 203-637-2250

MERCHANDISE FOR SALE

Heating & Firewood

CENTRAL BOILER E-Classic OUTDOOR FURNACES. Heat your entire home and hot water. EPA Qualified. Up to 92% Efficient. Call Today and save up $3500 203-263-2123

GUARANTEED SEASONED FIREWOOD
$230/cord delivered. Call 203-247-2505.

Merchandise for Sale

1995 POKEMON LIMITED EDITION COLLECTOR BALL With Gold Plated Card Inside. "Mewtoo" The Cat, Mint cond In Box. $30. 203-981-5913

2010 TICKET FOR ANY SIX FLAGS 2010 Six Flags entrance ticket worth $59.99 sell for $29.99. Pickup or I'll mail it. Credit Card OK. Margaret 203-536-9770

25ft Aluminum Extension Ladder Like New American Made 203-722-4948 cycleman@opton-

Merchandise for Sale

BARBIE DOLLS four 1966 Era Barbie Dolls No Boxes! All In Good Condition With Clothing, Asking $60. 203-981-5913

BASKETBALL CARDS
30 Old School Basketball Cards 1990's Era NBA Hoops, Topps Cards, Scottie Pippin, Bird, Ew-ing, Johnson, Etc... All In Good Condition! $30.00 203-981-5913

BASKETBALL/ WARM UP PANTS
Unisex in various colors BRAND NEW. Sizes Youth Sm, Youth Med. and Yourth Large. Super Low Price of $7.00 a pair or 2 pair for $12.00! 203-496-0130

BATHTUB
American Standard Americast tub. White. 60x34 Has been sitting in our warehouse. Need to make space. $150 BO. 203-667-1714

BIBLES (2)
old From Early 1900's Era Both In Good Condition! $50.00 For Both. 203-981-5913

BICYCLE
Diamond Back Viper 20" BMX Bike, never used and in box. Orig. $200, sell for $125. Call 203-249-2244 for more information.

Black Leather Couch 90" Black Leather Couch recliner, mint condition. Call Bill 203 979-3558. Will Deliver.

BOAT GAS TANK
1 Yamaha Plastic Portable Boat Gas Tank, Red, Brand New Condition! $40. 203-981-5913

BOTTLES
10 Misc. Old Deco

Merchandise for Sale

CEILING FAN
New in Box! 42" almond with polished brass with 3 light set. pd $68
asking $45 email me for picture
cycleczyman@optonline.net.
203-722-4948
$40.00

CELLO Beginner size Like New. NO SCRATCHES. it could be sold as new. Comes with Bow and soft carrying case with handle and back pack strapes. For the price of 1 yr rental you can own one. size is good up to middle school. $300. 203-722-4948 or cycleman@optonline.net

Cello
Beginner size Cello. Like New. NO SCRATCHES. it could be sold as new. Comes with Bow and soft carring case with handle and back pack strapes. For the price of 1 yr rental you can own one. size is good up to middle school. 203-722-4948 or cycleman@optonline.net
$299.00

CHAIRS
Set Of 2 Wooden Chairs Brown & Black in Color, Very Good Condition! Asking-$50. 203-981-5913

CHEST OF DRAWERS
5 drawers $25. call 203-249-7975

CHILDS LEARN & PLAY HARMONICA SET
By First Act Discovery, Includes Harmonica & Instructional Book. Great Condition! Perfect For The Beginner! $25.00 203-981-5913

CHILDRENS LEARN & PLAY HARMONICA SET

000021 NOV 1 10

Nancy Hamson

From: Greenwich Time [no-reply@kaango.com]
Sent: Saturday, October 16, 2010 6:06 AM
To: Nancy Hamson
Subject: Greenwich Time: Your ad, LEGAL NOTICE Statute Reference: 19a-639 Applicant: Greenwich Hospital Town: Greenwich Street Address: 5..., has been posted online in our marketplace!

Greenwich Time

Thank you for placing your advertisement with Greenwich Time.

Your online advertisement, "LEGAL NOTICE Statute Reference: 19a-639 Applicant: Greenwich Hospital Town: Greenwich Street Address: 5..." is now available at http://greenwichtime.kaango.com.

View your online advertisement by visiting
http://greenwichtime.kaango.com/ads/viewad?adid=17831189

You may add photos, change your description, and enhance your advertisement by visiting:
http://greenwichtime.kaango.com/feMyAds

You may login using the username and password below:

Username: nancy.hamson@greenwichhospital.org
Password: f9a3fea6

Thanks for using Greenwich Time.

Do not reply to this email. Your message will not be received
To opt-out of receiving these emails in the future please click here

LEGAL NOTICE Statute Reference: 19a-639 Applicant: Greenwich Hospital Town: Greenwich Street Address: 5...

Source: Greenwich Time

Category: Events & Notices » Legal & Public Notices

http://greenwichtime.kaango.com/ads/view?adid=17831189

LEGAL NOTICE Statute Reference: 19a-639 Applicant: Greenwich Hospital Town: Greenwich Street Address: 5 Perryridge Road Docket Number: 10-31647-CON Description: The applicant is seeking approval from the Office of Health Care Access for the acquisition of a CT Simulator.

Ad Details:

Ad ID: 17831189

Location: Greenwich, CT

Created: Oct 16, 2010

Expires: Oct 18, 2010

Member: tmp_852452

Nancy Hamson

From: Stamford Advocate [no-reply@kaango.com]
Sent: Sunday, October 17, 2010 6:04 AM
To: Nancy Hamson
Subject: Stamford Advocate: Your ad, LEGAL NOTICE Statute Reference: 19a-639 Applicant: Greenwich Hospital Town: Greenwich Street Address: 5..., has been posted online in our marketplace!

Stamford Advocate

Thank you for placing your advertisement with Stamford Advocate.

Your online advertisement, "LEGAL NOTICE Statute Reference: 19a-639 Applicant: Greenwich Hospital Town: Greenwich Street Address: 5..." is now available at http://stamfordadvocate.kaango.com.

View your online advertisement by visiting
http://stamfordadvocate.kaango.com/ads/viewad?adid=17835949

You may add photos, change your description, and enhance your advertisement by visiting:
http://stamfordadvocate.kaango.com/feMyAds

As a reminder, your username is below:

Username: nancy.hamson@greenwichhospital.org

Thanks for using Stamford Advocate.

Do not reply to this email. Your message will not be received
To opt-out of receiving these emails in the future please click here

LEGAL NOTICE Statute Reference: 19a-639 Applicant: Greenwich Hospital Town: Greenwich Street Address: 5...

Source: Stamford Advocate

Category: Events & Notices » Legal & Public Notices

http://stamfordadvocate.kaango.com/ads/view?adid=17835949

LEGAL NOTICE Statute Reference: 19a-639 Applicant: Greenwich Hospital Town: Greenwich Street Address: 5 Perryridge Road Docket Number: 10-31647-CON Description: The applicant is seeking approval from the Office of Health Care Access for the acquisition of a CT Simulator.

Ad Details:

Ad ID: 17835949

Location: Greenwich, CT

Created: Oct 17, 2010

Expires: Oct 25, 2010

Member: tmp_852452

Exhibit 1

Greenwich Hospital Service Area Populations - Male

MARKET	PONAME	DOMCTY	Age Grp	Sex	2009 Total	2014 Total
Greenwich	Cos Cob	Fairfield, CT	00-17	Male	951	909
Greenwich	Cos Cob	Fairfield, CT	18-44	Male	1042	1034
Greenwich	Cos Cob	Fairfield, CT	45-64	Male	1098	1114
Greenwich	Cos Cob	Fairfield, CT	65+	Male	488	538
Darien	Darien	Fairfield, CT	00-17	Male	3466	3420
Darien	Darien	Fairfield, CT	18-44	Male	2476	2541
Darien	Darien	Fairfield, CT	45-64	Male	2951	2951
Darien	Darien	Fairfield, CT	65+	Male	1104	1254
Greenwich	Greenwich	Fairfield, CT	00-17	Male	2753	2635
Greenwich	Greenwich	Fairfield, CT	18-44	Male	3758	3713
Greenwich	Greenwich	Fairfield, CT	45-64	Male	3339	3476
Greenwich	Greenwich	Fairfield, CT	65+	Male	1601	1762
Greenwich	Greenwich	Fairfield, CT	00-17	Male	1996	1926
Greenwich	Greenwich	Fairfield, CT	18-44	Male	1924	2004
Greenwich	Greenwich	Fairfield, CT	45-64	Male	2328	2263
Greenwich	Greenwich	Fairfield, CT	65+	Male	1206	1310
New Canaan	New Canaan	Fairfield, CT	00-17	Male	3096	3047
New Canaan	New Canaan	Fairfield, CT	18-44	Male	2272	2452
New Canaan	New Canaan	Fairfield, CT	45-64	Male	2974	2811
New Canaan	New Canaan	Fairfield, CT	65+	Male	1192	1374
Norwalk	Norwalk	Fairfield, CT	00-17	Male	2025	1915
Norwalk	Norwalk	Fairfield, CT	18-44	Male	3193	2970
Norwalk	Norwalk	Fairfield, CT	45-64	Male	2399	2605
Norwalk	Norwalk	Fairfield, CT	65+	Male	1053	1159
Norwalk	Norwalk	Fairfield, CT	00-17	Male	2911	2789
Norwalk	Norwalk	Fairfield, CT	18-44	Male	4539	4216
Norwalk	Norwalk	Fairfield, CT	45-64	Male	3710	4051
Norwalk	Norwalk	Fairfield, CT	65+	Male	1552	1744
Norwalk	Norwalk	Fairfield, CT	00-17	Male	420	416
Norwalk	Norwalk	Fairfield, CT	18-44	Male	413	364
Norwalk	Norwalk	Fairfield, CT	45-64	Male	525	535
Norwalk	Norwalk	Fairfield, CT	65+	Male	217	235
Norwalk	Norwalk	Fairfield, CT	00-17	Male	3432	3315
Norwalk	Norwalk	Fairfield, CT	18-44	Male	6089	5689
Norwalk	Norwalk	Fairfield, CT	45-64	Male	3442	3877
Norwalk	Norwalk	Fairfield, CT	65+	Male	1238	1468
Norwalk	Norwalk	Fairfield, CT	00-17	Male	837	802
Norwalk	Norwalk	Fairfield, CT	18-44	Male	1527	1381
Norwalk	Norwalk	Fairfield, CT	45-64	Male	1069	1167
Norwalk	Norwalk	Fairfield, CT	65+	Male	483	535
Greenwich	Old Greenwich	Fairfield, CT	00-17	Male	1173	1159
Greenwich	Old Greenwich	Fairfield, CT	18-44	Male	921	930

Greenwich	Old Greenwich	Fairfield, CT	45-64	Male	1046	1056
Greenwich	Old Greenwich	Fairfield, CT	65+	Male	444	489
Greenwich	Riverside	Fairfield, CT	00-17	Male	1230	1195
Greenwich	Riverside	Fairfield, CT	18-44	Male	928	952
Greenwich	Riverside	Fairfield, CT	45-64	Male	1095	1080
Greenwich	Riverside	Fairfield, CT	65+	Male	492	547
Westport	Westport	Fairfield, CT	00-17	Male	3815	3696
Westport	Westport	Fairfield, CT	18-44	Male	2903	3169
Westport	Westport	Fairfield, CT	45-64	Male	4328	4208
Westport	Westport	Fairfield, CT	65+	Male	1830	2050
Weston	Weston	Fairfield, CT	00-17	Male	1644	1571
Weston	Weston	Fairfield, CT	18-44	Male	1100	1207
Weston	Weston	Fairfield, CT	45-64	Male	1698	1588
Weston	Weston	Fairfield, CT	65+	Male	556	660
Wilton	Wilton	Fairfield, CT	00-17	Male	2820	2681
Wilton	Wilton	Fairfield, CT	18-44	Male	1988	2136
Wilton	Wilton	Fairfield, CT	45-64	Male	2803	2628
Wilton	Wilton	Fairfield, CT	65+	Male	999	1175
Stamford	Stamford	Fairfield, CT	00-17	Male	556	555
Stamford	Stamford	Fairfield, CT	18-44	Male	1971	1889
Stamford	Stamford	Fairfield, CT	45-64	Male	1037	1235
Stamford	Stamford	Fairfield, CT	65+	Male	377	464
Stamford	Stamford	Fairfield, CT	00-17	Male	7141	6985
Stamford	Stamford	Fairfield, CT	18-44	Male	12339	11502
Stamford	Stamford	Fairfield, CT	45-64	Male	7177	8056
Stamford	Stamford	Fairfield, CT	65+	Male	2924	3302
Stamford	Stamford	Fairfield, CT	00-17	Male	1956	1859
Stamford	Stamford	Fairfield, CT	18-44	Male	1683	1679
Stamford	Stamford	Fairfield, CT	45-64	Male	2303	2203
Stamford	Stamford	Fairfield, CT	65+	Male	1014	1102
Stamford	Stamford	Fairfield, CT	00-17	Male	2226	2219
Stamford	Stamford	Fairfield, CT	18-44	Male	3498	3244
Stamford	Stamford	Fairfield, CT	45-64	Male	2525	2788
Stamford	Stamford	Fairfield, CT	65+	Male	1184	1297
Stamford	Stamford	Fairfield, CT	00-17	Male	826	831
Stamford	Stamford	Fairfield, CT	18-44	Male	1676	1528
Stamford	Stamford	Fairfield, CT	45-64	Male	1024	1160
Stamford	Stamford	Fairfield, CT	65+	Male	454	494
Stamford	Stamford	Fairfield, CT	00-17	Male	952	915
Stamford	Stamford	Fairfield, CT	18-44	Male	1445	1332
Stamford	Stamford	Fairfield, CT	45-64	Male	1164	1232
Stamford	Stamford	Fairfield, CT	65+	Male	471	523
Armonk	Armonk	Westchester, NY	00-17	Male	1188	1202
Armonk	Armonk	Westchester, NY	18-44	Male	1069	1232
Armonk	Armonk	Westchester, NY	45-64	Male	1391	1362

Armonk	Armonk	Westchester, NY	65+	Male	487	584
Bedford	Bedford	Westchester, NY	00-17	Male	911	891
Bedford	Bedford	Westchester, NY	18-44	Male	665	740
Bedford	Bedford	Westchester, NY	45-64	Male	953	899
Bedford	Bedford	Westchester, NY	65+	Male	335	394
Bedford	Bedford Hills	Westchester, NY	00-17	Male	844	839
Bedford	Bedford Hills	Westchester, NY	18-44	Male	1067	1046
Bedford	Bedford Hills	Westchester, NY	45-64	Male	786	855
Bedford	Bedford Hills	Westchester, NY	65+	Male	302	337
Harrison	Harrison	Westchester, NY	00-17	Male	1674	1694
Harrison	Harrison	Westchester, NY	18-44	Male	2066	2118
Harrison	Harrison	Westchester, NY	45-64	Male	1895	2039
Harrison	Harrison	Westchester, NY	65+	Male	878	969
Greenburgh	Hartsdale	Westchester, NY	00-17	Male	1420	1419
Greenburgh	Hartsdale	Westchester, NY	18-44	Male	1950	1839
Greenburgh	Hartsdale	Westchester, NY	45-64	Male	2111	2290
Greenburgh	Hartsdale	Westchester, NY	65+	Male	973	1102
Bedford	Katonah	Westchester, NY	00-17	Male	1813	1799
Bedford	Katonah	Westchester, NY	18-44	Male	1690	1781
Bedford	Katonah	Westchester, NY	45-64	Male	1801	1791
Bedford	Katonah	Westchester, NY	65+	Male	632	762
Larchmont	Larchmont	Westchester, NY	00-17	Male	2422	2342
Larchmont	Larchmont	Westchester, NY	18-44	Male	2240	2237
Larchmont	Larchmont	Westchester, NY	45-64	Male	2358	2312
Larchmont	Larchmont	Westchester, NY	65+	Male	993	1106
Mamaroneck	Mamaroneck	Westchester, NY	00-17	Male	2323	2230
Mamaroneck	Mamaroneck	Westchester, NY	18-44	Male	3405	3299
Mamaroneck	Mamaroneck	Westchester, NY	45-64	Male	2719	2941
Mamaroneck	Mamaroneck	Westchester, NY	65+	Male	1235	1350
Mt. Kisco	Mount Kisco	Westchester, NY	00-17	Male	2106	2091
Mt. Kisco	Mount Kisco	Westchester, NY	18-44	Male	2951	2911
Mt. Kisco	Mount Kisco	Westchester, NY	45-64	Male	2314	2430
Mt. Kisco	Mount Kisco	Westchester, NY	65+	Male	804	956
Mount Vernon	Mount Vernon	Westchester, NY	00-17	Male	4841	4615
Mount Vernon	Mount Vernon	Westchester, NY	18-44	Male	6271	5907
Mount Vernon	Mount Vernon	Westchester, NY	45-64	Male	3949	4089
Mount Vernon	Mount Vernon	Westchester, NY	65+	Male	1611	1829
Mount Vernon	Mount Vernon	Westchester, NY	00-17	Male	1967	1985
Mount Vernon	Mount Vernon	Westchester, NY	18-44	Male	3386	3191
Mount Vernon	Mount Vernon	Westchester, NY	45-64	Male	2806	3045
Mount Vernon	Mount Vernon	Westchester, NY	65+	Male	1362	1526
Mount Vernon	Mount Vernon	Westchester, NY	00-17	Male	1304	1228
Mount Vernon	Mount Vernon	Westchester, NY	18-44	Male	1821	1777
Mount Vernon	Mount Vernon	Westchester, NY	45-64	Male	1174	1236
Mount Vernon	Mount Vernon	Westchester, NY	65+	Male	506	568

Port Chester	Port Chester	Westchester, NY	00-17	Male	4489	4487
Port Chester	Port Chester	Westchester, NY	18-44	Male	7562	7115
Port Chester	Port Chester	Westchester, NY	45-64	Male	4863	5399
Port Chester	Port Chester	Westchester, NY	65+	Male	2057	2303
Pound Ridge	Pound Ridge	Westchester, NY	00-17	Male	628	632
Pound Ridge	Pound Ridge	Westchester, NY	18-44	Male	596	622
Pound Ridge	Pound Ridge	Westchester, NY	45-64	Male	885	862
Pound Ridge	Pound Ridge	Westchester, NY	65+	Male	335	370
Purchase	Purchase	Westchester, NY	00-17	Male	520	542
Purchase	Purchase	Westchester, NY	18-44	Male	683	766
Purchase	Purchase	Westchester, NY	45-64	Male	487	495
Purchase	Purchase	Westchester, NY	65+	Male	210	246
Rye	Rye	Westchester, NY	00-17	Male	2658	2635
Rye	Rye	Westchester, NY	18-44	Male	2197	2279
Rye	Rye	Westchester, NY	45-64	Male	2392	2373
Rye	Rye	Westchester, NY	65+	Male	1027	1142
Scarsdale	Scarsdale	Westchester, NY	00-17	Male	5463	5312
Scarsdale	Scarsdale	Westchester, NY	18-44	Male	4888	5207
Scarsdale	Scarsdale	Westchester, NY	45-64	Male	5776	5509
Scarsdale	Scarsdale	Westchester, NY	65+	Male	2682	2952
Lewisboro	South Salem	Westchester, NY	00-17	Male	986	936
Lewisboro	South Salem	Westchester, NY	18-44	Male	869	910
Lewisboro	South Salem	Westchester, NY	45-64	Male	1138	1072
Lewisboro	South Salem	Westchester, NY	65+	Male	336	418
White Plains	White Plains	Westchester, NY	00-17	Male	1056	1095
White Plains	White Plains	Westchester, NY	18-44	Male	2149	2150
White Plains	White Plains	Westchester, NY	45-64	Male	1232	1494
White Plains	White Plains	Westchester, NY	65+	Male	525	637
Greenburgh	White Plains	Westchester, NY	00-17	Male	1890	1863
Greenburgh	White Plains	Westchester, NY	18-44	Male	2938	2861
Greenburgh	White Plains	Westchester, NY	45-64	Male	2304	2543
Greenburgh	White Plains	Westchester, NY	65+	Male	1007	1151
White Plains	West Harrison	Westchester, NY	00-17	Male	1242	1248
White Plains	West Harrison	Westchester, NY	18-44	Male	2016	1972
White Plains	West Harrison	Westchester, NY	45-64	Male	1358	1529
White Plains	West Harrison	Westchester, NY	65+	Male	625	685
White Plains	White Plains	Westchester, NY	00-17	Male	2126	2133
White Plains	White Plains	Westchester, NY	18-44	Male	2791	2862
White Plains	White Plains	Westchester, NY	45-64	Male	2804	2921
White Plains	White Plains	Westchester, NY	65+	Male	1420	1616
White Plains	White Plains	Westchester, NY	00-17	Male	1854	1842
White Plains	White Plains	Westchester, NY	18-44	Male	3466	3335
White Plains	White Plains	Westchester, NY	45-64	Male	2179	2467
White Plains	White Plains	Westchester, NY	65+	Male	873	1005
White Plains	White Plains	Westchester, NY	00-17	Male	740	742

White Plains	White Plains	Westchester, NY	18-44	Male	1177	1128
White Plains	White Plains	Westchester, NY	45-64	Male	1005	1033
White Plains	White Plains	Westchester, NY	65+	Male	481	555
New Rochelle	New Rochelle	Westchester, NY	00-17	Male	4604	4515
New Rochelle	New Rochelle	Westchester, NY	18-44	Male	7678	7429
New Rochelle	New Rochelle	Westchester, NY	45-64	Male	4317	4852
New Rochelle	New Rochelle	Westchester, NY	65+	Male	1835	2006
New Rochelle	New Rochelle	Westchester, NY	00-17	Male	1899	1867
New Rochelle	New Rochelle	Westchester, NY	18-44	Male	1797	1945
New Rochelle	New Rochelle	Westchester, NY	45-64	Male	2080	1937
New Rochelle	New Rochelle	Westchester, NY	65+	Male	1160	1260
New Rochelle	New Rochelle	Westchester, NY	00-17	Male	1677	1617
New Rochelle	New Rochelle	Westchester, NY	18-44	Male	3018	2742
New Rochelle	New Rochelle	Westchester, NY	45-64	Male	2171	2340
New Rochelle	New Rochelle	Westchester, NY	65+	Male	1204	1278
TOTAL					387019	392762

2009 CT	174825
2009 NY	212194
2014 CT	176338
2014 NY	216424

Greenwich Hospital Service Area Populations - Female

MARKET	PONAME	DOMCTY	Age Grp	Sex	2009 Total	2014 Total
Greenwich	Cos Cob	Fairfield, CT	00-17	Female	932	895
Greenwich	Cos Cob	Fairfield, CT	18-44	Female	1081	1019
Greenwich	Cos Cob	Fairfield, CT	45-64	Female	1210	1259
Greenwich	Cos Cob	Fairfield, CT	65+	Female	561	640
Darien	Darien	Fairfield, CT	00-17	Female	3170	3160
Darien	Darien	Fairfield, CT	18-44	Female	2635	2563
Darien	Darien	Fairfield, CT	45-64	Female	3082	3180
Darien	Darien	Fairfield, CT	65+	Female	1419	1616
Greenwich	Greenwich	Fairfield, CT	00-17	Female	2600	2513
Greenwich	Greenwich	Fairfield, CT	18-44	Female	3881	3643
Greenwich	Greenwich	Fairfield, CT	45-64	Female	3831	4005
Greenwich	Greenwich	Fairfield, CT	65+	Female	2468	2727
Greenwich	Greenwich	Fairfield, CT	00-17	Female	1876	1823
Greenwich	Greenwich	Fairfield, CT	18-44	Female	2059	2033
Greenwich	Greenwich	Fairfield, CT	45-64	Female	2539	2526
Greenwich	Greenwich	Fairfield, CT	65+	Female	1574	1738
New Canaan	New Canaan	Fairfield, CT	00-17	Female	2927	2893
New Canaan	New Canaan	Fairfield, CT	18-44	Female	2467	2493
New Canaan	New Canaan	Fairfield, CT	45-64	Female	3317	3249
New Canaan	New Canaan	Fairfield, CT	65+	Female	1619	1867
Norwalk	Norwalk	Fairfield, CT	00-17	Female	1805	1774
Norwalk	Norwalk	Fairfield, CT	18-44	Female	3052	2731
Norwalk	Norwalk	Fairfield, CT	45-64	Female	2551	2710
Norwalk	Norwalk	Fairfield, CT	65+	Female	1429	1590
Norwalk	Norwalk	Fairfield, CT	00-17	Female	2634	2591
Norwalk	Norwalk	Fairfield, CT	18-44	Female	4337	3887
Norwalk	Norwalk	Fairfield, CT	45-64	Female	3954	4272
Norwalk	Norwalk	Fairfield, CT	65+	Female	2243	2484
Norwalk	Norwalk	Fairfield, CT	00-17	Female	426	431
Norwalk	Norwalk	Fairfield, CT	18-44	Female	425	359
Norwalk	Norwalk	Fairfield, CT	45-64	Female	564	572
Norwalk	Norwalk	Fairfield, CT	65+	Female	262	291
Norwalk	Norwalk	Fairfield, CT	00-17	Female	3284	3173
Norwalk	Norwalk	Fairfield, CT	18-44	Female	5644	5190
Norwalk	Norwalk	Fairfield, CT	45-64	Female	3833	4193
Norwalk	Norwalk	Fairfield, CT	65+	Female	1730	2035
Norwalk	Norwalk	Fairfield, CT	00-17	Female	783	757
Norwalk	Norwalk	Fairfield, CT	18-44	Female	1394	1249
Norwalk	Norwalk	Fairfield, CT	45-64	Female	1111	1203
Norwalk	Norwalk	Fairfield, CT	65+	Female	655	724
Greenwich	Old Greenwich	Fairfield, CT	00-17	Female	1169	1149
Greenwich	Old Greenwich	Fairfield, CT	18-44	Female	943	916

Greenwich	Old Greenwich	Fairfield, CT	45-64	Female	1201	1243
Greenwich	Old Greenwich	Fairfield, CT	65+	Female	570	622
Greenwich	Riverside	Fairfield, CT	00-17	Female	1090	1066
Greenwich	Riverside	Fairfield, CT	18-44	Female	956	924
Greenwich	Riverside	Fairfield, CT	45-64	Female	1229	1237
Greenwich	Riverside	Fairfield, CT	65+	Female	619	691
Westport	Westport	Fairfield, CT	00-17	Female	3691	3564
Westport	Westport	Fairfield, CT	18-44	Female	3314	3314
Westport	Westport	Fairfield, CT	45-64	Female	4716	4784
Westport	Westport	Fairfield, CT	65+	Female	2276	2584
Weston	Weston	Fairfield, CT	00-17	Female	1588	1521
Weston	Weston	Fairfield, CT	18-44	Female	1226	1209
Weston	Weston	Fairfield, CT	45-64	Female	1785	1788
Weston	Weston	Fairfield, CT	65+	Female	603	757
Wilton	Wilton	Fairfield, CT	00-17	Female	2556	2445
Wilton	Wilton	Fairfield, CT	18-44	Female	2121	2067
Wilton	Wilton	Fairfield, CT	45-64	Female	2999	3001
Wilton	Wilton	Fairfield, CT	65+	Female	1410	1647
Stamford	Stamford	Fairfield, CT	00-17	Female	571	567
Stamford	Stamford	Fairfield, CT	18-44	Female	1553	1488
Stamford	Stamford	Fairfield, CT	45-64	Female	935	1091
Stamford	Stamford	Fairfield, CT	65+	Female	706	797
Stamford	Stamford	Fairfield, CT	00-17	Female	6787	6678
Stamford	Stamford	Fairfield, CT	18-44	Female	11621	10633
Stamford	Stamford	Fairfield, CT	45-64	Female	7790	8591
Stamford	Stamford	Fairfield, CT	65+	Female	4542	4986
Stamford	Stamford	Fairfield, CT	00-17	Female	1817	1721
Stamford	Stamford	Fairfield, CT	18-44	Female	1764	1646
Stamford	Stamford	Fairfield, CT	45-64	Female	2455	2455
Stamford	Stamford	Fairfield, CT	65+	Female	1153	1301
Stamford	Stamford	Fairfield, CT	00-17	Female	2112	2103
Stamford	Stamford	Fairfield, CT	18-44	Female	3246	2950
Stamford	Stamford	Fairfield, CT	45-64	Female	2726	2974
Stamford	Stamford	Fairfield, CT	65+	Female	1758	1895
Stamford	Stamford	Fairfield, CT	00-17	Female	786	774
Stamford	Stamford	Fairfield, CT	18-44	Female	1641	1483
Stamford	Stamford	Fairfield, CT	45-64	Female	1169	1288
Stamford	Stamford	Fairfield, CT	65+	Female	706	772
Stamford	Stamford	Fairfield, CT	00-17	Female	921	898
Stamford	Stamford	Fairfield, CT	18-44	Female	1453	1298
Stamford	Stamford	Fairfield, CT	45-64	Female	1256	1347
Stamford	Stamford	Fairfield, CT	65+	Female	644	696
Armonk	Armonk	Westchester, NY	00-17	Female	1182	1188
Armonk	Armonk	Westchester, NY	18-44	Female	1123	1234
Armonk	Armonk	Westchester, NY	45-64	Female	1414	1443

Armonk	Armonk	Westchester, NY	65+	Female	550	706
Bedford	Bedford	Westchester, NY	00-17	Female	850	834
Bedford	Bedford	Westchester, NY	18-44	Female	738	772
Bedford	Bedford	Westchester, NY	45-64	Female	993	961
Bedford	Bedford	Westchester, NY	65+	Female	356	451
Bedford	Bedford Hills	Westchester, NY	00-17	Female	708	700
Bedford	Bedford Hills	Westchester, NY	18-44	Female	1419	1405
Bedford	Bedford Hills	Westchester, NY	45-64	Female	952	1027
Bedford	Bedford Hills	Westchester, NY	65+	Female	412	456
Harrison	Harrison	Westchester, NY	00-17	Female	1650	1652
Harrison	Harrison	Westchester, NY	18-44	Female	2241	2248
Harrison	Harrison	Westchester, NY	45-64	Female	1987	2168
Harrison	Harrison	Westchester, NY	65+	Female	1149	1278
Greenburgh	Hartsdale	Westchester, NY	00-17	Female	1357	1368
Greenburgh	Hartsdale	Westchester, NY	18-44	Female	2057	1871
Greenburgh	Hartsdale	Westchester, NY	45-64	Female	2482	2650
Greenburgh	Hartsdale	Westchester, NY	65+	Female	1423	1602
Bedford	Katonah	Westchester, NY	00-17	Female	1645	1626
Bedford	Katonah	Westchester, NY	18-44	Female	2111	2122
Bedford	Katonah	Westchester, NY	45-64	Female	1965	2035
Bedford	Katonah	Westchester, NY	65+	Female	760	935
Larchmont	Larchmont	Westchester, NY	00-17	Female	2315	2225
Larchmont	Larchmont	Westchester, NY	18-44	Female	2403	2324
Larchmont	Larchmont	Westchester, NY	45-64	Female	2616	2622
Larchmont	Larchmont	Westchester, NY	65+	Female	1318	1449
Mamaroneck	Mamaroneck	Westchester, NY	00-17	Female	2230	2137
Mamaroneck	Mamaroneck	Westchester, NY	18-44	Female	3351	3227
Mamaroneck	Mamaroneck	Westchester, NY	45-64	Female	2915	3088
Mamaroneck	Mamaroneck	Westchester, NY	65+	Female	1831	2012
Mt. Kisco	Mount Kisco	Westchester, NY	00-17	Female	1953	1945
Mt. Kisco	Mount Kisco	Westchester, NY	18-44	Female	2550	2488
Mt. Kisco	Mount Kisco	Westchester, NY	45-64	Female	2497	2598
Mt. Kisco	Mount Kisco	Westchester, NY	65+	Female	1083	1261
Mount Vernon	Mount Vernon	Westchester, NY	00-17	Female	4679	4340
Mount Vernon	Mount Vernon	Westchester, NY	18-44	Female	7360	6796
Mount Vernon	Mount Vernon	Westchester, NY	45-64	Female	4981	5121
Mount Vernon	Mount Vernon	Westchester, NY	65+	Female	2614	2840
Mount Vernon	Mount Vernon	Westchester, NY	00-17	Female	2001	1998
Mount Vernon	Mount Vernon	Westchester, NY	18-44	Female	3553	3263
Mount Vernon	Mount Vernon	Westchester, NY	45-64	Female	3165	3422
Mount Vernon	Mount Vernon	Westchester, NY	65+	Female	2346	2579
Mount Vernon	Mount Vernon	Westchester, NY	00-17	Female	1273	1179
Mount Vernon	Mount Vernon	Westchester, NY	18-44	Female	2081	1970
Mount Vernon	Mount Vernon	Westchester, NY	45-64	Female	1601	1633
Mount Vernon	Mount Vernon	Westchester, NY	65+	Female	814	929

Port Chester	Port Chester	Westchester, NY	00-17	Female	4392	4397
Port Chester	Port Chester	Westchester, NY	18-44	Female	6506	6155
Port Chester	Port Chester	Westchester, NY	45-64	Female	4887	5342
Port Chester	Port Chester	Westchester, NY	65+	Female	3035	3282
Pound Ridge	Pound Ridge	Westchester, NY	00-17	Female	649	631
Pound Ridge	Pound Ridge	Westchester, NY	18-44	Female	624	656
Pound Ridge	Pound Ridge	Westchester, NY	45-64	Female	936	920
Pound Ridge	Pound Ridge	Westchester, NY	65+	Female	343	420
Purchase	Purchase	Westchester, NY	00-17	Female	512	542
Purchase	Purchase	Westchester, NY	18-44	Female	973	1044
Purchase	Purchase	Westchester, NY	45-64	Female	507	540
Purchase	Purchase	Westchester, NY	65+	Female	240	291
Rye	Rye	Westchester, NY	00-17	Female	2509	2479
Rye	Rye	Westchester, NY	18-44	Female	2424	2420
Rye	Rye	Westchester, NY	45-64	Female	2553	2582
Rye	Rye	Westchester, NY	65+	Female	1339	1472
Scarsdale	Scarsdale	Westchester, NY	00-17	Female	5191	5066
Scarsdale	Scarsdale	Westchester, NY	18-44	Female	5243	5300
Scarsdale	Scarsdale	Westchester, NY	45-64	Female	6502	6334
Scarsdale	Scarsdale	Westchester, NY	65+	Female	3384	3800
Lewisboro	South Salem	Westchester, NY	00-17	Female	979	927
Lewisboro	South Salem	Westchester, NY	18-44	Female	949	912
Lewisboro	South Salem	Westchester, NY	45-64	Female	1175	1186
Lewisboro	South Salem	Westchester, NY	65+	Female	357	460
White Plains	White Plains	Westchester, NY	00-17	Female	1053	1082
White Plains	White Plains	Westchester, NY	18-44	Female	2167	2129
White Plains	White Plains	Westchester, NY	45-64	Female	1396	1641
White Plains	White Plains	Westchester, NY	65+	Female	1104	1252
Greenburgh	White Plains	Westchester, NY	00-17	Female	1708	1710
Greenburgh	White Plains	Westchester, NY	18-44	Female	3066	2859
Greenburgh	White Plains	Westchester, NY	45-64	Female	2790	3042
Greenburgh	White Plains	Westchester, NY	65+	Female	1568	1768
White Plains	West Harrison	Westchester, NY	00-17	Female	1246	1241
White Plains	West Harrison	Westchester, NY	18-44	Female	2270	2197
White Plains	West Harrison	Westchester, NY	45-64	Female	1499	1677
White Plains	West Harrison	Westchester, NY	65+	Female	919	1008
White Plains	White Plains	Westchester, NY	00-17	Female	2053	2092
White Plains	White Plains	Westchester, NY	18-44	Female	2791	2750
White Plains	White Plains	Westchester, NY	45-64	Female	3272	3394
White Plains	White Plains	Westchester, NY	65+	Female	1917	2180
White Plains	White Plains	Westchester, NY	00-17	Female	1772	1764
White Plains	White Plains	Westchester, NY	18-44	Female	2943	2833
White Plains	White Plains	Westchester, NY	45-64	Female	2217	2458
White Plains	White Plains	Westchester, NY	65+	Female	1499	1654
White Plains	White Plains	Westchester, NY	00-17	Female	751	736

White Plains	White Plains	Westchester, NY	18-44	Female	1076	1050
White Plains	White Plains	Westchester, NY	45-64	Female	1134	1147
White Plains	White Plains	Westchester, NY	65+	Female	620	713
New Rochelle	New Rochelle	Westchester, NY	00-17	Female	4381	4332
New Rochelle	New Rochelle	Westchester, NY	18-44	Female	7147	6868
New Rochelle	New Rochelle	Westchester, NY	45-64	Female	4720	5114
New Rochelle	New Rochelle	Westchester, NY	65+	Female	3045	3243
New Rochelle	New Rochelle	Westchester, NY	00-17	Female	1843	1802
New Rochelle	New Rochelle	Westchester, NY	18-44	Female	1891	1974
New Rochelle	New Rochelle	Westchester, NY	45-64	Female	2259	2161
New Rochelle	New Rochelle	Westchester, NY	65+	Female	1332	1474
New Rochelle	New Rochelle	Westchester, NY	00-17	Female	1581	1538
New Rochelle	New Rochelle	Westchester, NY	18-44	Female	3601	3268
New Rochelle	New Rochelle	Westchester, NY	45-64	Female	2353	2506
New Rochelle	New Rochelle	Westchester, NY	65+	Female	2067	2186
TOTAL					413852	419198

2009 CT	183538
2009 NY	230314
2014 CT	185019
2014 NY	234179

Greenwich Hospital Service Area Populations - Combined

MARKET	PONAME	DOMCTY	Age Grp	Sex	2009 Total	2014 Total
Greenwich	Cos Cob	Fairfield, CT	00-17	Female	932	895
Greenwich	Cos Cob	Fairfield, CT	00-17	Male	951	909
Greenwich	Cos Cob	Fairfield, CT	18-44	Female	1081	1019
Greenwich	Cos Cob	Fairfield, CT	18-44	Male	1042	1034
Greenwich	Cos Cob	Fairfield, CT	45-64	Female	1210	1259
Greenwich	Cos Cob	Fairfield, CT	45-64	Male	1098	1114
Greenwich	Cos Cob	Fairfield, CT	65+	Female	561	640
Greenwich	Cos Cob	Fairfield, CT	65+	Male	488	538
Darien	Darien	Fairfield, CT	00-17	Female	3170	3160
Darien	Darien	Fairfield, CT	00-17	Male	3466	3420
Darien	Darien	Fairfield, CT	18-44	Female	2635	2563
Darien	Darien	Fairfield, CT	18-44	Male	2476	2541
Darien	Darien	Fairfield, CT	45-64	Female	3082	3180
Darien	Darien	Fairfield, CT	45-64	Male	2951	2951
Darien	Darien	Fairfield, CT	65+	Female	1419	1616
Darien	Darien	Fairfield, CT	65+	Male	1104	1254
Greenwich	Greenwich	Fairfield, CT	00-17	Female	2600	2513
Greenwich	Greenwich	Fairfield, CT	00-17	Male	2753	2635
Greenwich	Greenwich	Fairfield, CT	18-44	Female	3881	3643
Greenwich	Greenwich	Fairfield, CT	18-44	Male	3758	3713
Greenwich	Greenwich	Fairfield, CT	45-64	Female	3831	4005
Greenwich	Greenwich	Fairfield, CT	45-64	Male	3339	3476
Greenwich	Greenwich	Fairfield, CT	65+	Female	2468	2727
Greenwich	Greenwich	Fairfield, CT	65+	Male	1601	1762
Greenwich	Greenwich	Fairfield, CT	00-17	Female	1876	1823
Greenwich	Greenwich	Fairfield, CT	00-17	Male	1996	1926
Greenwich	Greenwich	Fairfield, CT	18-44	Female	2059	2033
Greenwich	Greenwich	Fairfield, CT	18-44	Male	1924	2004
Greenwich	Greenwich	Fairfield, CT	45-64	Female	2539	2526
Greenwich	Greenwich	Fairfield, CT	45-64	Male	2328	2263
Greenwich	Greenwich	Fairfield, CT	65+	Female	1574	1738
Greenwich	Greenwich	Fairfield, CT	65+	Male	1206	1310
New Canaan	New Canaan	Fairfield, CT	00-17	Female	2927	2893
New Canaan	New Canaan	Fairfield, CT	00-17	Male	3096	3047
New Canaan	New Canaan	Fairfield, CT	18-44	Female	2467	2493
New Canaan	New Canaan	Fairfield, CT	18-44	Male	2272	2452
New Canaan	New Canaan	Fairfield, CT	45-64	Female	3317	3249
New Canaan	New Canaan	Fairfield, CT	45-64	Male	2974	2811
New Canaan	New Canaan	Fairfield, CT	65+	Female	1619	1867
New Canaan	New Canaan	Fairfield, CT	65+	Male	1192	1374
Norwalk	Norwalk	Fairfield, CT	00-17	Female	1805	1774
Norwalk	Norwalk	Fairfield, CT	00-17	Male	2025	1915

Norwalk	Norwalk	Fairfield, CT	18-44	Female	3052	2731
Norwalk	Norwalk	Fairfield, CT	18-44	Male	3193	2970
Norwalk	Norwalk	Fairfield, CT	45-64	Female	2551	2710
Norwalk	Norwalk	Fairfield, CT	45-64	Male	2399	2605
Norwalk	Norwalk	Fairfield, CT	65+	Female	1429	1590
Norwalk	Norwalk	Fairfield, CT	65+	Male	1053	1159
Norwalk	Norwalk	Fairfield, CT	00-17	Female	2634	2591
Norwalk	Norwalk	Fairfield, CT	00-17	Male	2911	2789
Norwalk	Norwalk	Fairfield, CT	18-44	Female	4337	3887
Norwalk	Norwalk	Fairfield, CT	18-44	Male	4539	4216
Norwalk	Norwalk	Fairfield, CT	45-64	Female	3954	4272
Norwalk	Norwalk	Fairfield, CT	45-64	Male	3710	4051
Norwalk	Norwalk	Fairfield, CT	65+	Female	2243	2484
Norwalk	Norwalk	Fairfield, CT	65+	Male	1552	1744
Norwalk	Norwalk	Fairfield, CT	00-17	Female	426	431
Norwalk	Norwalk	Fairfield, CT	00-17	Male	420	416
Norwalk	Norwalk	Fairfield, CT	18-44	Female	425	359
Norwalk	Norwalk	Fairfield, CT	18-44	Male	413	364
Norwalk	Norwalk	Fairfield, CT	45-64	Female	564	572
Norwalk	Norwalk	Fairfield, CT	45-64	Male	525	535
Norwalk	Norwalk	Fairfield, CT	65+	Female	262	291
Norwalk	Norwalk	Fairfield, CT	65+	Male	217	235
Norwalk	Norwalk	Fairfield, CT	00-17	Female	3284	3173
Norwalk	Norwalk	Fairfield, CT	00-17	Male	3432	3315
Norwalk	Norwalk	Fairfield, CT	18-44	Female	5644	5190
Norwalk	Norwalk	Fairfield, CT	18-44	Male	6089	5689
Norwalk	Norwalk	Fairfield, CT	45-64	Female	3833	4193
Norwalk	Norwalk	Fairfield, CT	45-64	Male	3442	3877
Norwalk	Norwalk	Fairfield, CT	65+	Female	1730	2035
Norwalk	Norwalk	Fairfield, CT	65+	Male	1238	1468
Norwalk	Norwalk	Fairfield, CT	00-17	Female	783	757
Norwalk	Norwalk	Fairfield, CT	00-17	Male	837	802
Norwalk	Norwalk	Fairfield, CT	18-44	Female	1394	1249
Norwalk	Norwalk	Fairfield, CT	18-44	Male	1527	1381
Norwalk	Norwalk	Fairfield, CT	45-64	Female	1111	1203
Norwalk	Norwalk	Fairfield, CT	45-64	Male	1069	1167
Norwalk	Norwalk	Fairfield, CT	65+	Female	655	724
Norwalk	Norwalk	Fairfield, CT	65+	Male	483	535
Greenwich	Old Greenwich	Fairfield, CT	00-17	Female	1169	1149
Greenwich	Old Greenwich	Fairfield, CT	00-17	Male	1173	1159
Greenwich	Old Greenwich	Fairfield, CT	18-44	Female	943	916
Greenwich	Old Greenwich	Fairfield, CT	18-44	Male	921	930
Greenwich	Old Greenwich	Fairfield, CT	45-64	Female	1201	1243
Greenwich	Old Greenwich	Fairfield, CT	45-64	Male	1046	1056
Greenwich	Old Greenwich	Fairfield, CT	65+	Female	570	622

Greenwich	Old Greenwich	Fairfield, CT	65+	Male	444	489
Greenwich	Riverside	Fairfield, CT	00-17	Female	1090	1066
Greenwich	Riverside	Fairfield, CT	00-17	Male	1230	1195
Greenwich	Riverside	Fairfield, CT	18-44	Female	956	924
Greenwich	Riverside	Fairfield, CT	18-44	Male	928	952
Greenwich	Riverside	Fairfield, CT	45-64	Female	1229	1237
Greenwich	Riverside	Fairfield, CT	45-64	Male	1095	1080
Greenwich	Riverside	Fairfield, CT	65+	Female	619	691
Greenwich	Riverside	Fairfield, CT	65+	Male	492	547
Westport	Westport	Fairfield, CT	00-17	Female	3691	3564
Westport	Westport	Fairfield, CT	00-17	Male	3815	3696
Westport	Westport	Fairfield, CT	18-44	Female	3314	3314
Westport	Westport	Fairfield, CT	18-44	Male	2903	3169
Westport	Westport	Fairfield, CT	45-64	Female	4716	4784
Westport	Westport	Fairfield, CT	45-64	Male	4328	4208
Westport	Westport	Fairfield, CT	65+	Female	2276	2584
Westport	Westport	Fairfield, CT	65+	Male	1830	2050
Weston	Weston	Fairfield, CT	00-17	Female	1588	1521
Weston	Weston	Fairfield, CT	00-17	Male	1644	1571
Weston	Weston	Fairfield, CT	18-44	Female	1226	1209
Weston	Weston	Fairfield, CT	18-44	Male	1100	1207
Weston	Weston	Fairfield, CT	45-64	Female	1785	1788
Weston	Weston	Fairfield, CT	45-64	Male	1698	1588
Weston	Weston	Fairfield, CT	65+	Female	603	757
Weston	Weston	Fairfield, CT	65+	Male	556	660
Wilton	Wilton	Fairfield, CT	00-17	Female	2556	2445
Wilton	Wilton	Fairfield, CT	00-17	Male	2820	2681
Wilton	Wilton	Fairfield, CT	18-44	Female	2121	2067
Wilton	Wilton	Fairfield, CT	18-44	Male	1988	2136
Wilton	Wilton	Fairfield, CT	45-64	Female	2999	3001
Wilton	Wilton	Fairfield, CT	45-64	Male	2803	2628
Wilton	Wilton	Fairfield, CT	65+	Female	1410	1647
Wilton	Wilton	Fairfield, CT	65+	Male	999	1175
Stamford	Stamford	Fairfield, CT	00-17	Female	571	567
Stamford	Stamford	Fairfield, CT	00-17	Male	556	555
Stamford	Stamford	Fairfield, CT	18-44	Female	1553	1488
Stamford	Stamford	Fairfield, CT	18-44	Male	1971	1889
Stamford	Stamford	Fairfield, CT	45-64	Female	935	1091
Stamford	Stamford	Fairfield, CT	45-64	Male	1037	1235
Stamford	Stamford	Fairfield, CT	65+	Female	706	797
Stamford	Stamford	Fairfield, CT	65+	Male	377	464
Stamford	Stamford	Fairfield, CT	00-17	Female	6787	6678
Stamford	Stamford	Fairfield, CT	00-17	Male	7141	6985
Stamford	Stamford	Fairfield, CT	18-44	Female	11621	10633
Stamford	Stamford	Fairfield, CT	18-44	Male	12339	11502

Stamford	Stamford	Fairfield, CT	45-64	Female	7790	8591
Stamford	Stamford	Fairfield, CT	45-64	Male	7177	8056
Stamford	Stamford	Fairfield, CT	65+	Female	4542	4986
Stamford	Stamford	Fairfield, CT	65+	Male	2924	3302
Stamford	Stamford	Fairfield, CT	00-17	Female	1817	1721
Stamford	Stamford	Fairfield, CT	00-17	Male	1956	1859
Stamford	Stamford	Fairfield, CT	18-44	Female	1764	1646
Stamford	Stamford	Fairfield, CT	18-44	Male	1683	1679
Stamford	Stamford	Fairfield, CT	45-64	Female	2455	2455
Stamford	Stamford	Fairfield, CT	45-64	Male	2303	2203
Stamford	Stamford	Fairfield, CT	65+	Female	1153	1301
Stamford	Stamford	Fairfield, CT	65+	Male	1014	1102
Stamford	Stamford	Fairfield, CT	00-17	Female	2112	2103
Stamford	Stamford	Fairfield, CT	00-17	Male	2226	2219
Stamford	Stamford	Fairfield, CT	18-44	Female	3246	2950
Stamford	Stamford	Fairfield, CT	18-44	Male	3498	3244
Stamford	Stamford	Fairfield, CT	45-64	Female	2726	2974
Stamford	Stamford	Fairfield, CT	45-64	Male	2525	2788
Stamford	Stamford	Fairfield, CT	65+	Female	1758	1895
Stamford	Stamford	Fairfield, CT	65+	Male	1184	1297
Stamford	Stamford	Fairfield, CT	00-17	Female	786	774
Stamford	Stamford	Fairfield, CT	00-17	Male	826	831
Stamford	Stamford	Fairfield, CT	18-44	Female	1641	1483
Stamford	Stamford	Fairfield, CT	18-44	Male	1676	1528
Stamford	Stamford	Fairfield, CT	45-64	Female	1169	1288
Stamford	Stamford	Fairfield, CT	45-64	Male	1024	1160
Stamford	Stamford	Fairfield, CT	65+	Female	706	772
Stamford	Stamford	Fairfield, CT	65+	Male	454	494
Stamford	Stamford	Fairfield, CT	00-17	Female	921	898
Stamford	Stamford	Fairfield, CT	00-17	Male	952	915
Stamford	Stamford	Fairfield, CT	18-44	Female	1453	1298
Stamford	Stamford	Fairfield, CT	18-44	Male	1445	1332
Stamford	Stamford	Fairfield, CT	45-64	Female	1256	1347
Stamford	Stamford	Fairfield, CT	45-64	Male	1164	1232
Stamford	Stamford	Fairfield, CT	65+	Female	644	696
Stamford	Stamford	Fairfield, CT	65+	Male	471	523
Armonk	Armonk	Westchester, NY	00-17	Female	1182	1188
Armonk	Armonk	Westchester, NY	00-17	Male	1188	1202
Armonk	Armonk	Westchester, NY	18-44	Female	1123	1234
Armonk	Armonk	Westchester, NY	18-44	Male	1069	1232
Armonk	Armonk	Westchester, NY	45-64	Female	1414	1443
Armonk	Armonk	Westchester, NY	45-64	Male	1391	1362
Armonk	Armonk	Westchester, NY	65+	Female	550	706
Armonk	Armonk	Westchester, NY	65+	Male	487	584
Bedford	Bedford	Westchester, NY	00-17	Female	850	834

Bedford	Bedford	Westchester, NY	00-17	Male	911	891
Bedford	Bedford	Westchester, NY	18-44	Female	738	772
Bedford	Bedford	Westchester, NY	18-44	Male	665	740
Bedford	Bedford	Westchester, NY	45-64	Female	993	961
Bedford	Bedford	Westchester, NY	45-64	Male	953	899
Bedford	Bedford	Westchester, NY	65+	Female	356	451
Bedford	Bedford	Westchester, NY	65+	Male	335	394
Bedford	Bedford Hills	Westchester, NY	00-17	Female	708	700
Bedford	Bedford Hills	Westchester, NY	00-17	Male	844	839
Bedford	Bedford Hills	Westchester, NY	18-44	Female	1419	1405
Bedford	Bedford Hills	Westchester, NY	18-44	Male	1067	1046
Bedford	Bedford Hills	Westchester, NY	45-64	Female	952	1027
Bedford	Bedford Hills	Westchester, NY	45-64	Male	786	855
Bedford	Bedford Hills	Westchester, NY	65+	Female	412	456
Bedford	Bedford Hills	Westchester, NY	65+	Male	302	337
Harrison	Harrison	Westchester, NY	00-17	Female	1650	1652
Harrison	Harrison	Westchester, NY	00-17	Male	1674	1694
Harrison	Harrison	Westchester, NY	18-44	Female	2241	2248
Harrison	Harrison	Westchester, NY	18-44	Male	2066	2118
Harrison	Harrison	Westchester, NY	45-64	Female	1987	2168
Harrison	Harrison	Westchester, NY	45-64	Male	1895	2039
Harrison	Harrison	Westchester, NY	65+	Female	1149	1278
Harrison	Harrison	Westchester, NY	65+	Male	878	969
Greenburgh	Hartsdale	Westchester, NY	00-17	Female	1357	1368
Greenburgh	Hartsdale	Westchester, NY	00-17	Male	1420	1419
Greenburgh	Hartsdale	Westchester, NY	18-44	Female	2057	1871
Greenburgh	Hartsdale	Westchester, NY	18-44	Male	1950	1839
Greenburgh	Hartsdale	Westchester, NY	45-64	Female	2482	2650
Greenburgh	Hartsdale	Westchester, NY	45-64	Male	2111	2290
Greenburgh	Hartsdale	Westchester, NY	65+	Female	1423	1602
Greenburgh	Hartsdale	Westchester, NY	65+	Male	973	1102
Bedford	Katonah	Westchester, NY	00-17	Female	1645	1626
Bedford	Katonah	Westchester, NY	00-17	Male	1813	1799
Bedford	Katonah	Westchester, NY	18-44	Female	2111	2122
Bedford	Katonah	Westchester, NY	18-44	Male	1690	1781
Bedford	Katonah	Westchester, NY	45-64	Female	1965	2035
Bedford	Katonah	Westchester, NY	45-64	Male	1801	1791
Bedford	Katonah	Westchester, NY	65+	Female	760	935
Bedford	Katonah	Westchester, NY	65+	Male	632	762
Larchmont	Larchmont	Westchester, NY	00-17	Female	2315	2225
Larchmont	Larchmont	Westchester, NY	00-17	Male	2422	2342
Larchmont	Larchmont	Westchester, NY	18-44	Female	2403	2324
Larchmont	Larchmont	Westchester, NY	18-44	Male	2240	2237
Larchmont	Larchmont	Westchester, NY	45-64	Female	2616	2622
Larchmont	Larchmont	Westchester, NY	45-64	Male	2358	2312

Larchmont	Larchmont	Westchester, NY	65+	Female	1318	1449
Larchmont	Larchmont	Westchester, NY	65+	Male	993	1106
Mamaroneck	Mamaroneck	Westchester, NY	00-17	Female	2230	2137
Mamaroneck	Mamaroneck	Westchester, NY	00-17	Male	2323	2230
Mamaroneck	Mamaroneck	Westchester, NY	18-44	Female	3351	3227
Mamaroneck	Mamaroneck	Westchester, NY	18-44	Male	3405	3299
Mamaroneck	Mamaroneck	Westchester, NY	45-64	Female	2915	3088
Mamaroneck	Mamaroneck	Westchester, NY	45-64	Male	2719	2941
Mamaroneck	Mamaroneck	Westchester, NY	65+	Female	1831	2012
Mamaroneck	Mamaroneck	Westchester, NY	65+	Male	1235	1350
Mt. Kisco	Mount Kisco	Westchester, NY	00-17	Female	1953	1945
Mt. Kisco	Mount Kisco	Westchester, NY	00-17	Male	2106	2091
Mt. Kisco	Mount Kisco	Westchester, NY	18-44	Female	2550	2488
Mt. Kisco	Mount Kisco	Westchester, NY	18-44	Male	2951	2911
Mt. Kisco	Mount Kisco	Westchester, NY	45-64	Female	2497	2598
Mt. Kisco	Mount Kisco	Westchester, NY	45-64	Male	2314	2430
Mt. Kisco	Mount Kisco	Westchester, NY	65+	Female	1083	1261
Mt. Kisco	Mount Kisco	Westchester, NY	65+	Male	804	956
Mount Vernon	Mount Vernon	Westchester, NY	00-17	Female	4679	4340
Mount Vernon	Mount Vernon	Westchester, NY	00-17	Male	4841	4615
Mount Vernon	Mount Vernon	Westchester, NY	18-44	Female	7360	6796
Mount Vernon	Mount Vernon	Westchester, NY	18-44	Male	6271	5907
Mount Vernon	Mount Vernon	Westchester, NY	45-64	Female	4981	5121
Mount Vernon	Mount Vernon	Westchester, NY	45-64	Male	3949	4089
Mount Vernon	Mount Vernon	Westchester, NY	65+	Female	2614	2840
Mount Vernon	Mount Vernon	Westchester, NY	65+	Male	1611	1829
Mount Vernon	Mount Vernon	Westchester, NY	00-17	Female	2001	1998
Mount Vernon	Mount Vernon	Westchester, NY	00-17	Male	1967	1985
Mount Vernon	Mount Vernon	Westchester, NY	18-44	Female	3553	3263
Mount Vernon	Mount Vernon	Westchester, NY	18-44	Male	3386	3191
Mount Vernon	Mount Vernon	Westchester, NY	45-64	Female	3165	3422
Mount Vernon	Mount Vernon	Westchester, NY	45-64	Male	2806	3045
Mount Vernon	Mount Vernon	Westchester, NY	65+	Female	2346	2579
Mount Vernon	Mount Vernon	Westchester, NY	65+	Male	1362	1526
Mount Vernon	Mount Vernon	Westchester, NY	00-17	Female	1273	1179
Mount Vernon	Mount Vernon	Westchester, NY	00-17	Male	1304	1228
Mount Vernon	Mount Vernon	Westchester, NY	18-44	Female	2081	1970
Mount Vernon	Mount Vernon	Westchester, NY	18-44	Male	1821	1777
Mount Vernon	Mount Vernon	Westchester, NY	45-64	Female	1601	1633
Mount Vernon	Mount Vernon	Westchester, NY	45-64	Male	1174	1236
Mount Vernon	Mount Vernon	Westchester, NY	65+	Female	814	929
Mount Vernon	Mount Vernon	Westchester, NY	65+	Male	506	568
Port Chester	Port Chester	Westchester, NY	00-17	Female	4392	4397
Port Chester	Port Chester	Westchester, NY	00-17	Male	4489	4487
Port Chester	Port Chester	Westchester, NY	18-44	Female	6506	6155

Port Chester	Port Chester	Westchester, NY	18-44	Male	7562	7115
Port Chester	Port Chester	Westchester, NY	45-64	Female	4887	5342
Port Chester	Port Chester	Westchester, NY	45-64	Male	4863	5399
Port Chester	Port Chester	Westchester, NY	65+	Female	3035	3282
Port Chester	Port Chester	Westchester, NY	65+	Male	2057	2303
Pound Ridge	Pound Ridge	Westchester, NY	00-17	Female	649	631
Pound Ridge	Pound Ridge	Westchester, NY	00-17	Male	628	632
Pound Ridge	Pound Ridge	Westchester, NY	18-44	Female	624	656
Pound Ridge	Pound Ridge	Westchester, NY	18-44	Male	596	622
Pound Ridge	Pound Ridge	Westchester, NY	45-64	Female	936	920
Pound Ridge	Pound Ridge	Westchester, NY	45-64	Male	885	862
Pound Ridge	Pound Ridge	Westchester, NY	65+	Female	343	420
Pound Ridge	Pound Ridge	Westchester, NY	65+	Male	335	370
Purchase	Purchase	Westchester, NY	00-17	Female	512	542
Purchase	Purchase	Westchester, NY	00-17	Male	520	542
Purchase	Purchase	Westchester, NY	18-44	Female	973	1044
Purchase	Purchase	Westchester, NY	18-44	Male	683	766
Purchase	Purchase	Westchester, NY	45-64	Female	507	540
Purchase	Purchase	Westchester, NY	45-64	Male	487	495
Purchase	Purchase	Westchester, NY	65+	Female	240	291
Purchase	Purchase	Westchester, NY	65+	Male	210	246
Rye	Rye	Westchester, NY	00-17	Female	2509	2479
Rye	Rye	Westchester, NY	00-17	Male	2658	2635
Rye	Rye	Westchester, NY	18-44	Female	2424	2420
Rye	Rye	Westchester, NY	18-44	Male	2197	2279
Rye	Rye	Westchester, NY	45-64	Female	2553	2582
Rye	Rye	Westchester, NY	45-64	Male	2392	2373
Rye	Rye	Westchester, NY	65+	Female	1339	1472
Rye	Rye	Westchester, NY	65+	Male	1027	1142
Scarsdale	Scarsdale	Westchester, NY	00-17	Female	5191	5066
Scarsdale	Scarsdale	Westchester, NY	00-17	Male	5463	5312
Scarsdale	Scarsdale	Westchester, NY	18-44	Female	5243	5300
Scarsdale	Scarsdale	Westchester, NY	18-44	Male	4888	5207
Scarsdale	Scarsdale	Westchester, NY	45-64	Female	6502	6334
Scarsdale	Scarsdale	Westchester, NY	45-64	Male	5776	5509
Scarsdale	Scarsdale	Westchester, NY	65+	Female	3384	3800
Scarsdale	Scarsdale	Westchester, NY	65+	Male	2682	2952
Lewisboro	South Salem	Westchester, NY	00-17	Female	979	927
Lewisboro	South Salem	Westchester, NY	00-17	Male	986	936
Lewisboro	South Salem	Westchester, NY	18-44	Female	949	912
Lewisboro	South Salem	Westchester, NY	18-44	Male	869	910
Lewisboro	South Salem	Westchester, NY	45-64	Female	1175	1186
Lewisboro	South Salem	Westchester, NY	45-64	Male	1138	1072
Lewisboro	South Salem	Westchester, NY	65+	Female	357	460
Lewisboro	South Salem	Westchester, NY	65+	Male	336	418

White Plains	White Plains	Westchester, NY	00-17	Female	1053	1082
White Plains	White Plains	Westchester, NY	00-17	Male	1056	1095
White Plains	White Plains	Westchester, NY	18-44	Female	2167	2129
White Plains	White Plains	Westchester, NY	18-44	Male	2149	2150
White Plains	White Plains	Westchester, NY	45-64	Female	1396	1641
White Plains	White Plains	Westchester, NY	45-64	Male	1232	1494
White Plains	White Plains	Westchester, NY	65+	Female	1104	1252
White Plains	White Plains	Westchester, NY	65+	Male	525	637
Greenburgh	White Plains	Westchester, NY	00-17	Female	1708	1710
Greenburgh	White Plains	Westchester, NY	00-17	Male	1890	1863
Greenburgh	White Plains	Westchester, NY	18-44	Female	3066	2859
Greenburgh	White Plains	Westchester, NY	18-44	Male	2938	2861
Greenburgh	White Plains	Westchester, NY	45-64	Female	2790	3042
Greenburgh	White Plains	Westchester, NY	45-64	Male	2304	2543
Greenburgh	White Plains	Westchester, NY	65+	Female	1568	1768
Greenburgh	White Plains	Westchester, NY	65+	Male	1007	1151
White Plains	West Harrison	Westchester, NY	00-17	Female	1246	1241
White Plains	West Harrison	Westchester, NY	00-17	Male	1242	1248
White Plains	West Harrison	Westchester, NY	18-44	Female	2270	2197
White Plains	West Harrison	Westchester, NY	18-44	Male	2016	1972
White Plains	West Harrison	Westchester, NY	45-64	Female	1499	1677
White Plains	West Harrison	Westchester, NY	45-64	Male	1358	1529
White Plains	West Harrison	Westchester, NY	65+	Female	919	1008
White Plains	West Harrison	Westchester, NY	65+	Male	625	685
White Plains	White Plains	Westchester, NY	00-17	Female	2053	2092
White Plains	White Plains	Westchester, NY	00-17	Male	2126	2133
White Plains	White Plains	Westchester, NY	18-44	Female	2791	2750
White Plains	White Plains	Westchester, NY	18-44	Male	2791	2862
White Plains	White Plains	Westchester, NY	45-64	Female	3272	3394
White Plains	White Plains	Westchester, NY	45-64	Male	2804	2921
White Plains	White Plains	Westchester, NY	65+	Female	1917	2180
White Plains	White Plains	Westchester, NY	65+	Male	1420	1616
White Plains	White Plains	Westchester, NY	00-17	Female	1772	1764
White Plains	White Plains	Westchester, NY	00-17	Male	1854	1842
White Plains	White Plains	Westchester, NY	18-44	Female	2943	2833
White Plains	White Plains	Westchester, NY	18-44	Male	3466	3335
White Plains	White Plains	Westchester, NY	45-64	Female	2217	2458
White Plains	White Plains	Westchester, NY	45-64	Male	2179	2467
White Plains	White Plains	Westchester, NY	65+	Female	1499	1654
White Plains	White Plains	Westchester, NY	65+	Male	873	1005
White Plains	White Plains	Westchester, NY	00-17	Female	751	736
White Plains	White Plains	Westchester, NY	00-17	Male	740	742
White Plains	White Plains	Westchester, NY	18-44	Female	1076	1050
White Plains	White Plains	Westchester, NY	18-44	Male	1177	1128
White Plains	White Plains	Westchester, NY	45-64	Female	1134	1147

White Plains	White Plains	Westchester, NY	45-64	Male	1005	1033
White Plains	White Plains	Westchester, NY	65+	Female	620	713
White Plains	White Plains	Westchester, NY	65+	Male	481	555
New Rochelle	New Rochelle	Westchester, NY	00-17	Female	4381	4332
New Rochelle	New Rochelle	Westchester, NY	00-17	Male	4604	4515
New Rochelle	New Rochelle	Westchester, NY	18-44	Female	7147	6868
New Rochelle	New Rochelle	Westchester, NY	18-44	Male	7678	7429
New Rochelle	New Rochelle	Westchester, NY	45-64	Female	4720	5114
New Rochelle	New Rochelle	Westchester, NY	45-64	Male	4317	4852
New Rochelle	New Rochelle	Westchester, NY	65+	Female	3045	3243
New Rochelle	New Rochelle	Westchester, NY	65+	Male	1835	2006
New Rochelle	New Rochelle	Westchester, NY	00-17	Female	1843	1802
New Rochelle	New Rochelle	Westchester, NY	00-17	Male	1899	1867
New Rochelle	New Rochelle	Westchester, NY	18-44	Female	1891	1974
New Rochelle	New Rochelle	Westchester, NY	18-44	Male	1797	1945
New Rochelle	New Rochelle	Westchester, NY	45-64	Female	2259	2161
New Rochelle	New Rochelle	Westchester, NY	45-64	Male	2080	1937
New Rochelle	New Rochelle	Westchester, NY	65+	Female	1332	1474
New Rochelle	New Rochelle	Westchester, NY	65+	Male	1160	1260
New Rochelle	New Rochelle	Westchester, NY	00-17	Female	1581	1538
New Rochelle	New Rochelle	Westchester, NY	00-17	Male	1677	1617
New Rochelle	New Rochelle	Westchester, NY	18-44	Female	3601	3268
New Rochelle	New Rochelle	Westchester, NY	18-44	Male	3018	2742
New Rochelle	New Rochelle	Westchester, NY	45-64	Female	2353	2506
New Rochelle	New Rochelle	Westchester, NY	45-64	Male	2171	2340
New Rochelle	New Rochelle	Westchester, NY	65+	Female	2067	2186
New Rochelle	New Rochelle	Westchester, NY	65+	Male	1204	1278
TOTAL					800871	811960

Cancer Facts & Figures 2010

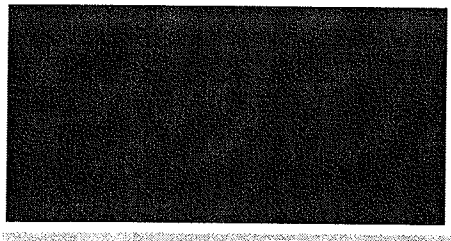
Estimated number of new cancer cases for 2010, excluding basal and squamous cell skin cancers and in situ carcinomas except urinary bladder.
Note: State estimates are offered as a rough guide and should be interpreted with caution. State estimates may not add to US total due to rounding.

Special Section:
Prostate Cancer
see page 23

American Cancer Society®

Contents

**Indicates a figure or table*



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Cancer: Basic Facts

What Is Cancer?

Cancer is a group of diseases characterized by uncontrolled growth and spread of abnormal cells. If the spread is not controlled, it can result in death. Cancer is caused by both external factors (tobacco, infectious organisms, chemicals, and radiation) and internal factors (inherited mutations, hormones, immune conditions, and mutations that occur from metabolism). These causal factors may act together or in sequence to initiate or promote carcinogenesis. Ten or more years often pass between exposure to external factors and detectable cancer. Cancer is treated with surgery, radiation, chemotherapy, hormone therapy, biological therapy, and targeted therapy.

Can Cancer Be Prevented?

All cancers caused by cigarette smoking and heavy use of alcohol could be prevented completely. The American Cancer Society estimates that in 2010 about 171,000 cancer deaths are expected to be caused by tobacco use. Scientific evidence suggests that about one-third of the 569,490 cancer deaths expected to occur in 2010 will be related to overweight or obesity, physical inactivity, and poor nutrition and thus could also be prevented. Certain cancers are related to infectious agents, such as hepatitis B virus (HBV), human papillomavirus (HPV), human immunodeficiency virus (HIV), *Helicobacter pylori (H. pylori),* and others, and could be prevented through behavioral changes, vaccines, or antibiotics. In addition, many of the more than 1 million skin cancers that are expected to be diagnosed in 2010 could be prevented by protection from the sun's rays and avoiding indoor tanning.

Regular screening examinations by a health care professional can result in the detection and removal of precancerous growths, as well as the diagnosis of cancers at an early stage, when they are most treatable. Cancers that can be prevented by removal of precancerous tissue include cancers of the cervix, colon, and rectum. Cancers that can be diagnosed early through screening include cancers of the breast, colon, rectum, cervix, prostate, oral cavity, and skin. For cancers of the breast, colon, rectum, and cervix, early detection has been proven to reduce mortality. A heightened awareness of breast changes or skin changes may also result in detection of these tumors at earlier stages. Cancers that can be prevented or detected earlier by screening account for at least half of all new cancer cases.

Who Is at Risk of Developing Cancer?

Anyone can develop cancer. Since the risk of being diagnosed with cancer increases as individuals age, most cases occur in adults who are middle-aged or older. About 78% of all cancers are diagnosed in persons 55 years and older. Cancer researchers use the word "risk" in different ways, most commonly expressing risk as lifetime risk or relative risk.

Lifetime risk refers to the probability that an individual, over the course of a lifetime, will develop or die from cancer. In the US, men have slightly less than a 1 in 2 lifetime risk of developing cancer; for women, the risk is a little more than 1 in 3.

Relative risk is a measure of the strength of the relationship between risk factors and a particular cancer. It compares the risk of developing cancer in persons with a certain exposure or trait to the risk in persons who do not have this characteristic. For example, male smokers are about 23 times more likely to develop lung cancer than nonsmokers, so their relative risk is 23. Most relative risks are not this large. For example, women who have a first-degree relative (mother, sister, or daughter) with a history of breast cancer have about twice the risk of developing breast cancer, compared to women who do not have this family history.

All cancers involve the malfunction of genes that control cell growth and division. About 5% of all cancers are strongly hereditary, in that an inherited genetic alteration confers a very high risk of developing one or more specific types of cancer. However, most cancers do not result from inherited genes but from damage to genes occurring during one's lifetime. Genetic damage may result from internal factors, such as hormones or the metabolism of nutrients within cells, or external factors, such as tobacco, chemicals, and sunlight.

How Many People Alive Today Have Ever Had Cancer?

The National Cancer Institute estimates that approximately 11.4 million Americans with a history of cancer were alive in January 2006. Some of these individuals were cancer-free, while others still had evidence of cancer and may have been undergoing treatment.

How Many New Cases Are Expected to Occur This Year?

About 1,529,560 new cancer cases are expected to be diagnosed in 2010. This estimate does not include carcinoma in situ (noninvasive cancer) of any site except urinary bladder, and does not include basal and squamous cell skin cancers, which are not required to be reported to cancer registries. More than 2 million people were treated for basal and squamous cell skin cancers in 2006.

How Many People Are Expected to Die of Cancer This Year?

This year, about 569,490 Americans are expected to die of cancer, more than 1,500 people a day. Cancer is the second most common cause of death in the US, exceeded only by heart disease. In the US, cancer accounts for nearly 1 of every 4 deaths.

What Percentage of People Survive Cancer?

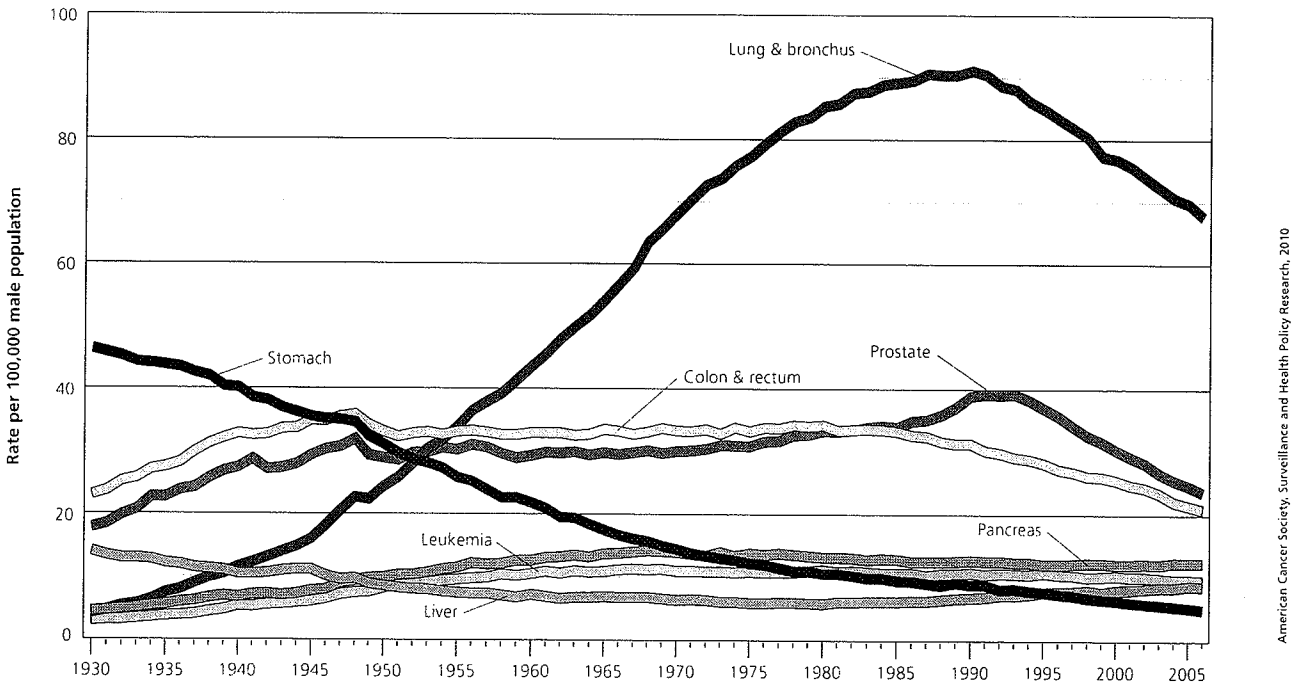
The 5-year relative survival rate for all cancers diagnosed between 1999-2005 is 68%, up from 50% in 1975-1977. (See page 18.) The improvement in survival reflects progress in diagnosing certain cancers at an earlier stage and improvements in treatment. Survival statistics vary greatly by cancer type and stage at diagnosis. Relative survival compares survival among cancer patients to that of people not diagnosed with cancer who are of the same age, race, and sex. It represents the percentage of cancer patients who are alive after some designated time period (usually 5 years) relative to persons without cancer. It does not distinguish between patients who have been cured and those who have relapsed or are still in treatment. While 5-year relative survival is useful in monitoring progress in the early detection and treatment of cancer, it does not represent the proportion of people who are cured permanently, since cancer deaths can occur beyond 5 years after diagnosis.

Although relative survival for specific cancer types provides some indication about the average survival experience of cancer patients in a given population, it may or may not predict individual prognosis and should be interpreted with caution. First, 5-year relative survival rates for the most recent time period are based on patients who were diagnosed from 1999 to 2005 and do not reflect recent advances in detection and treatment. Second, factors that influence survival, such as treatment protocols, additional illnesses, and biological or behavioral differences of each individual, cannot be taken into account in the estimation of relative survival rates. For more information about survival rates, see Sources of Statistics on page 59.

How Is Cancer Staged?

Staging describes the extent or spread of the disease at the time of diagnosis. Proper staging is essential in determining the

Age-adjusted Cancer Death Rates,* Males by Site, US, 1930-2006



*Per 100,000, age adjusted to the 2000 US standard population.

Note: Due to changes in ICD coding, numerator information has changed over time. Rates for cancer of the liver, lung and bronchus, and colon and rectum are affected by these coding changes.

Source: US Mortality Data, 1960 to 2006, US Mortality Volumes, 1930 to 1959, National Center for Health Statistics, Centers for Disease Control and Prevention, 2009.

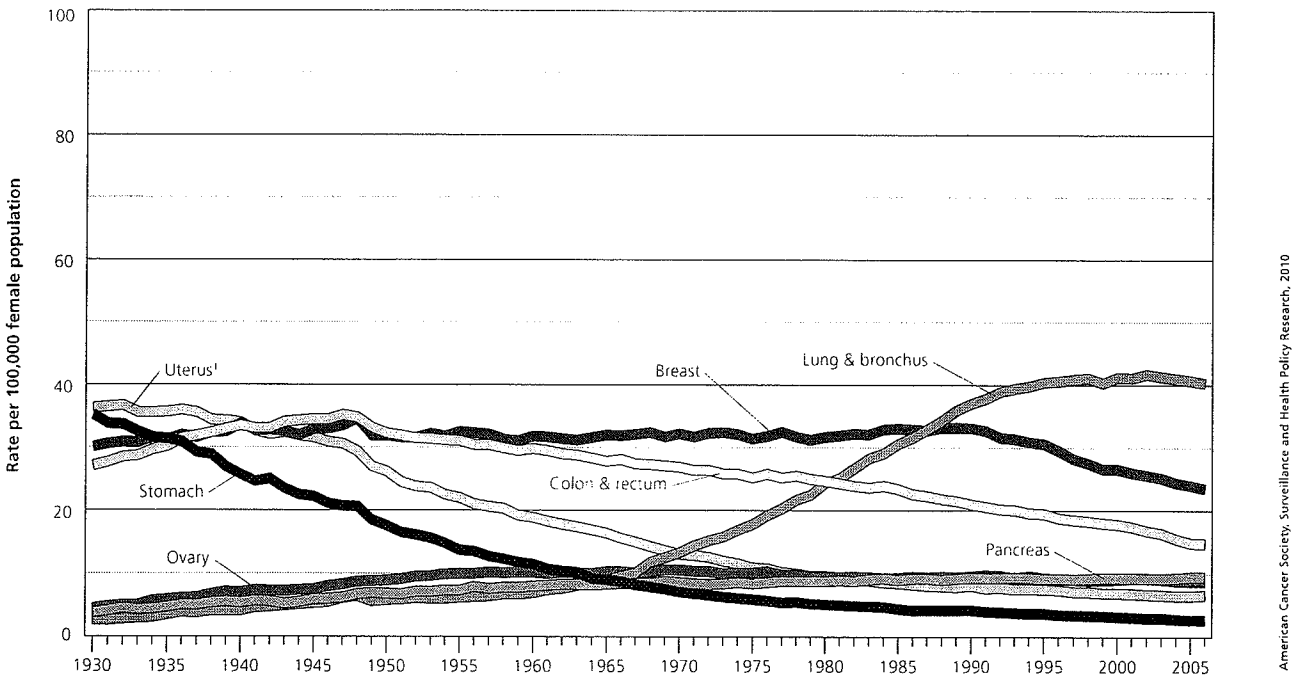
choice of therapy and in assessing prognosis. A cancer's stage is based on the primary tumor's size and whether it has spread to other areas of the body. A number of different staging systems are used to classify tumors. The TNM staging system assesses tumors in three ways: extent of the primary tumor (T), absence or presence of regional lymph node involvement (N), and absence or presence of distant metastases (M). Once the T, N, and M are determined, a stage of I, II, III, or IV is assigned, with stage I being early and stage IV being advanced disease. A different system of summary staging (in situ, local, regional, and distant) is used for descriptive and statistical analysis of tumor registry data. If cancer cells are present only in the layer of cells where they developed and have not spread, the stage is in situ. If cancer cells have penetrated the original layer of tissue, the cancer is invasive. (For a description of the other summary stage categories, see Five-year Relative Survival Rates by Stage at Diagnosis, 1999-2005, page 17.) As the molecular properties of cancer have become better understood, prognostic models have been developed for some cancer sites that incorporate biological markers and genetic features in addition to anatomical characteristics.

What Are the Costs of Cancer?

The National Institutes of Health estimates overall costs of cancer in 2010 at $263.8 billion: $102.8 billion for direct medical costs (total of all health expenditures); $20.9 billion for indirect morbidity costs (cost of lost productivity due to illness); and $140.1 billion for indirect mortality costs (cost of lost productivity due to premature death).

Lack of health insurance and other barriers prevents many Americans from receiving optimal health care. According to the US Census Bureau, 46 million Americans were uninsured in 2008; approximately 28% of Americans aged 18 to 34 years and 10% of children had no health insurance coverage. Uninsured patients and those from ethnic minorities are substantially more likely to be diagnosed with cancer at a later stage, when treatment can be more extensive and more costly. For more information on the relationship between health insurance and cancer, see *Cancer Facts & Figures 2008*, Special Section, available online at cancer.org.

Age-adjusted Cancer Death Rates,* Females by Site, US, 1930-2006



*Per 100,000, age adjusted to the 2000 US standard population. ¹Rates are uterine cervix and uterine corpus combined.

Note: Due to changes in ICD coding, numerator information has changed over time. Rates for cancer of the lung and bronchus, colon and rectum, and ovary are affected by these coding changes.

Source: US Mortality Data, 1960 to 2006, US Mortality Volumes, 1930 to 1959, National Center for Health Statistics, Centers for Disease Control and Prevention, 2009.

Estimated New Cancer Cases and Deaths by Sex for All Sites, US, 2010*

	Estimated New Cases			Estimated Deaths		
	Both Sexes	Male	Female	Both Sexes	Male	Female
All Sites	1,529,560	789,620	739,940	569,490	299,200	270,290
Oral cavity & pharynx	36,540	25,420	11,120	7,880	5,430	2,450
Tongue	10,990	7,690	3,300	1,990	1,300	690
Mouth	10,840	6,430	4,410	1,830	1,140	690
Pharynx	12,660	9,880	2,780	2,410	1,730	680
Other oral cavity	2,050	1,420	630	1,650	1,260	390
Digestive system	274,330	148,540	125,790	139,580	79,010	60,570
Esophagus	16,640	13,130	3,510	14,500	11,650	2,850
Stomach	21,000	12,730	8,270	10,570	6,350	4,220
Small intestine	6,960	3,680	3,280	1,100	610	490
Colon†	102,900	49,470	53,430	51,370	26,580	24,790
Rectum	39,670	22,620	17,050			
Anus, anal canal, & anorectum	5,260	2,000	3,260	720	280	440
Liver & intrahepatic bile duct	24,120	17,430	6,690	18,910	12,720	6,190
Gallbladder & other biliary	9,760	4,450	5,310	3,320	1,240	2,080
Pancreas	43,140	21,370	21,770	36,800	18,770	18,030
Other digestive organs	4,880	1,660	3,220	2,290	810	1,480
Respiratory system	240,610	130,600	110,010	161,670	89,550	72,120
Larynx	12,720	10,110	2,610	3,600	2,870	730
Lung & bronchus	222,520	116,750	105,770	157,300	86,220	71,080
Other respiratory organs	5,370	3,740	1,630	770	460	310
Bones & joints	2,650	1,530	1,120	1,460	830	630
Soft tissue (including heart)	10,520	5,680	4,840	3,920	2,020	1,900
Skin (excluding basal & squamous)	74,010	42,610	31,400	11,790	7,910	3,880
Melanoma-skin	68,130	38,870	29,260	8,700	5,670	3,030
Other nonepithelial skin	5,880	3,740	2,140	3,090	2,240	850
Breast	209,060	1,970	207,090	40,230	390	39,840
Genital system	311,210	227,460	83,750	60,420	32,710	27,710
Uterine cervix	12,200		12,200	4,210		4,210
Uterine corpus	43,470		43,470	7,950		7,950
Ovary	21,880		21,880	13,850		13,850
Vulva	3,900		3,900	920		920
Vagina & other genital, female	2,300		2,300	780		780
Prostate	217,730	217,730		32,050	32,050	
Testis	8,480	8,480		350	350	
Penis & other genital, male	1,250	1,250		310	310	
Urinary system	131,260	89,620	41,640	28,550	19,110	9,440
Urinary bladder	70,530	52,760	17,770	14,680	10,410	4,270
Kidney & renal pelvis	58,240	35,370	22,870	13,040	8,210	4,830
Ureter & other urinary organs	2,490	1,490	1,000	830	490	340
Eye & orbit	2,480	1,240	1,240	230	120	110
Brain & other nervous system	22,020	11,980	10,040	13,140	7,420	5,720
Endocrine system	46,930	11,890	35,040	2,570	1,140	1,430
Thyroid	44,670	10,740	33,930	1,690	730	960
Other endocrine	2,260	1,150	1,110	880	410	470
Lymphoma	74,030	40,050	33,980	21,530	11,450	10,080
Hodgkin lymphoma	8,490	4,670	3,820	1,320	740	580
Non-Hodgkin lymphoma	65,540	35,380	30,160	20,210	10,710	9,500
Myeloma	20,180	11,170	9,010	10,650	5,760	4,890
Leukemia	43,050	24,690	18,360	21,840	12,660	9,180
Acute lymphocytic leukemia	5,330	3,150	2,180	1,420	790	630
Chronic lymphocytic leukemia	14,990	8,870	6,120	4,390	2,650	1,740
Acute myeloid leukemia	12,330	6,590	5,740	8,950	5,280	3,670
Chronic myeloid leukemia	4,870	2,800	2,070	440	190	250
Other leukemia‡	5,530	3,280	2,250	6,640	3,750	2,890
Other & unspecified primary sites‡	30,680	15,170	15,510	44,030	23,690	20,340

*Rounded to the nearest 10; estimated new cases exclude basal and squamous cell skin cancers and in situ carcinomas except urinary bladder. About 54,010 female carcinoma in situ of the breast and 46,770 melanoma in situ will be newly diagnosed in 2010. †Estimated deaths for colon and rectum cancers are combined. ‡More deaths than cases may reflect lack of specificity in recording underlying cause of death on death certificates or an undercount in the case estimate.

Source: Estimated new cases are based on 1995-2006 incidence rates from 44 states and the District of Columbia as reported by the North American Association of Central Cancer Registries (NAACCR), represesnting about 89% of the US population. Estimated deaths are based on data from US Mortality Data, 1969 to 2007, National Center for Health Statistics, Centers for Disease Control and Prevention, 2010.

Estimated New Cancer Cases for Selected Cancer Sites by State, US, 2010*

State	All Sites	Female Breast	Uterine Cervix	Colon & Rectum	Uterine Corpus	Leukemia	Lung & Bronchus	Melanoma of the Skin	Non-Hodgkin Lymphoma	Prostate	Urinary Bladder
Alabama	23,640	3,450	200	2,300	520	560	4,160	1,210	940	3,300	920
Alaska	2,860	410	†	260	70	70	360	80	130	440	140
Arizona	29,780	3,950	210	2,620	710	760	4,030	1,430	1,210	3,850	1,530
Arkansas	15,320	1,770	140	1,500	330	420	2,620	460	640	2,330	610
California	157,320	21,130	1,540	13,950	4,470	4,460	18,490	8,030	7,010	22,640	6,620
Colorado	21,340	3,100	150	1,770	570	650	2,270	1,180	920	3,430	960
Connecticut	20,750	2,960	120	1,770	650	510	2,640	1,090	860	2,940	1,110
Delaware	4,890	690	†	440	140	120	800	210	200	710	250
Dist. of Columbia	2,760	390	†	260	80	60	360	70	100	450	90
Florida	107,000	14,080	940	10,500	2,710	3,330	18,390	4,980	4,660	14,610	5,600
Georgia	40,480	6,130	390	3,840	950	1,040	6,280	2,020	1,600	6,380	1,470
Hawaii	6,670	910	50	680	220	160	770	310	230	1,060	200
Idaho	7,220	910	60	600	200	230	860	360	310	1,300	380
Illinois	63,890	8,770	490	6,340	1,960	1,860	9,190	2,060	2,690	8,730	3,050
Indiana	33,020	4,350	230	3,330	960	890	5,430	1,200	1,370	4,160	1,510
Iowa	17,260	2,020	100	1,760	550	560	2,450	900	750	2,420	840
Kansas	13,550	1,780	90	1,270	410	400	1,990	650	590	1,630	550
Kentucky	24,240	3,290	210	2,370	610	630	4,780	1,440	1,030	3,180	1,030
Louisiana	20,950	2,530	180	2,060	440	590	3,320	600	920	3,410	850
Maine	8,650	1,160	50	800	280	260	1,370	410	360	1,410	530
Maryland	27,700	4,150	200	2,630	810	620	4,170	1,290	1,110	4,010	1,180
Massachusetts	36,040	5,320	200	3,120	1,150	910	5,020	1,770	1,460	4,820	2,000
Michigan	55,660	7,340	330	5,170	1,700	1,600	8,150	2,240	2,400	8,490	2,790
Minnesota	25,080	3,330	140	2,410	850	830	3,150	970	1,100	3,870	1,160
Mississippi	14,330	1,970	130	1,480	300	340	2,360	470	540	2,260	510
Missouri	31,160	3,880	210	3,080	910	870	5,360	1,320	1,260	3,600	1,360
Montana	5,570	680	†	490	150	160	740	200	240	960	280
Nebraska	9,230	1,160	60	910	290	290	1,200	450	410	1,470	420
Nevada	12,230	1,350	130	1,090	290	320	1,920	410	480	1,750	620
New Hampshire	7,810	990	†	720	240	200	1,070	390	310	1,100	430
New Jersey	48,100	6,820	420	4,430	1,580	1,330	6,260	2,650	2,130	6,790	2,510
New Mexico	9,210	1,180	90	790	230	280	920	420	370	1,610	350
New York	103,340	14,610	930	9,780	3,430	2,980	13,720	4,050	4,680	14,840	5,230
North Carolina	45,120	6,500	360	4,220	1,190	1,150	7,520	2,130	1,800	6,910	1,890
North Dakota	3,300	400	†	340	100	100	410	120	150	580	180
Ohio	64,450	8,280	410	5,960	2,010	1,810	10,710	2,200	2,720	8,010	2,970
Oklahoma	18,670	2,300	150	1,730	460	560	3,250	640	810	2,440	770
Oregon	20,750	2,910	130	1,710	600	530	2,810	1,200	930	3,010	1,040
Pennsylvania	75,260	10,000	540	7,440	2,450	2,070	10,520	3,550	3,430	9,800	4,050
Rhode Island	5,970	790	†	540	190	160	840	290	240	740	350
South Carolina	23,240	3,260	170	2,140	560	590	3,970	1,060	950	3,600	950
South Dakota	4,220	530	†	450	130	130	540	170	180	760	230
Tennessee	33,070	4,700	270	3,130	750	850	5,980	1,720	1,360	4,600	1,350
Texas	101,120	12,920	1,070	9,190	2,420	3,240	14,030	3,570	4,410	13,740	3,650
Utah	9,970	1,260	80	740	280	310	620	610	430	1,730	390
Vermont	3,720	520	†	320	110	90	490	190	150	600	210
Virginia	36,410	5,470	280	3,370	1,040	880	5,510	1,810	1,470	5,550	1,520
Washington	34,500	4,900	220	2,740	1,010	1,000	4,320	1,930	1,600	5,220	1,720
West Virginia	10,610	1,310	80	1,060	330	280	2,070	440	450	1,440	530
Wisconsin	29,610	4,120	200	2,760	1,040	940	3,990	1,050	1,340	4,670	1,510
Wyoming	2,540	330	†	220	70	70	320	110	110	420	130
United States	1,529,560	207,090	12,200	142,570	43,470	43,050	222,520	68,130	65,540	217,730	70,530

*Rounded to nearest 10. Excludes basal and squamous cell skin cancers and in situ carcinomas except urinary bladder. †Estimate is fewer than 50 cases.

Note: These estimates are offered as a rough guide and should be interpreted with caution. State estimates may not sum to US total due to rounding and exclusion of state estimates fewer than 50 cases.

Estimated Deaths for Selected Cancer Sites by State, US, 2010*

State	All Sites	Brain/ Nervous System	Female Breast	Colon & Rectum	Leukemia	Liver	Lung & Bronchus	Non-Hodgkin Lymphoma	Ovary	Pancreas	Prostate
Alabama	10,150	210	690	950	350	310	3,190	320	260	590	600
Alaska	880	†	70	80	†	†	250	†	†	60	†
Arizona	10,630	280	740	1,020	420	380	2,670	360	290	740	650
Arkansas	6,460	150	430	600	240	200	1,900	200	140	430	460
California	55,710	1,490	4,230	4,970	2,220	2,600	12,630	2,110	1,500	3,900	3,710
Colorado	6,880	210	500	660	270	230	1,670	280	210	460	390
Connecticut	6,850	150	490	540	230	200	1,760	230	180	540	410
Delaware	1,900	†	120	160	70	50	580	60	†	120	100
Dist. of Columbia	960	†	80	100	†	†	230	†	†	70	70
Florida	40,880	800	2,650	3,540	1,560	1,360	11,620	1,480	930	2,560	2,590
Georgia	15,570	340	1,100	1,430	560	430	4,620	500	390	940	930
Hawaii	2,330	†	140	220	80	120	570	90	50	180	120
Idaho	2,530	80	160	220	120	70	640	90	60	190	180
Illinois	23,360	470	1,790	2,310	900	700	6,490	740	570	1,580	1,420
Indiana	12,900	340	860	1,130	520	340	4,000	440	300	790	620
Iowa	6,370	170	380	620	300	160	1,770	290	170	380	370
Kansas	5,370	140	370	530	260	140	1,590	200	140	330	300
Kentucky	9,670	180	580	880	320	250	3,410	310	200	540	470
Louisiana	8,480	210	620	920	310	340	2,550	280	200	540	440
Maine	3,170	80	170	270	110	80	960	90	70	200	150
Maryland	10,250	210	800	950	390	360	2,760	310	250	710	650
Massachusetts	12,990	280	780	1,050	470	440	3,530	400	330	920	600
Michigan	20,740	500	1,320	1,740	810	600	5,830	700	500	1,330	1,010
Minnesota	9,200	240	610	780	390	280	2,450	330	220	600	440
Mississippi	6,060	130	400	630	230	190	2,010	190	130	360	330
Missouri	12,620	280	860	1,120	540	380	3,950	450	250	790	710
Montana	1,980	60	110	170	90	50	580	80	50	120	130
Nebraska	3,500	90	210	360	140	80	900	150	80	200	240
Nevada	4,640	120	330	530	110	180	1,300	150	110	300	270
New Hampshire	2,660	70	190	210	90	80	750	70	60	190	140
New Jersey	16,520	340	1,430	1,600	600	470	4,220	640	430	1,130	940
New Mexico	3,400	80	230	340	120	150	780	120	80	230	240
New York	34,540	800	2,490	3,120	1,380	1,270	8,720	1,480	910	2,440	1,690
North Carolina	19,100	350	1,340	1,520	650	500	5,650	570	390	1,160	980
North Dakota	1,280	†	80	120	60	†	320	†	†	90	70
Ohio	24,980	540	1,730	2,280	930	680	7,260	840	540	1,530	1,440
Oklahoma	7,660	170	520	700	290	220	2,390	280	160	400	320
Oregon	7,510	210	490	690	280	230	2,100	310	210	490	430
Pennsylvania	28,690	550	1,980	2,610	1,100	840	7,960	1,100	730	2,010	1,660
Rhode Island	2,170	50	130	150	90	70	600	60	60	120	80
South Carolina	9,180	200	640	770	330	270	2,870	300	220	560	490
South Dakota	1,670	†	100	160	70	†	450	60	50	100	100
Tennessee	13,600	340	890	1,190	490	380	4,520	470	250	750	690
Texas	36,540	840	2,780	3,340	1,410	1,660	9,600	1,280	840	2,200	1,820
Utah	2,820	100	250	250	140	80	480	100	80	200	200
Vermont	1,280	†	90	120	50	†	370	†	†	80	50
Virginia	14,230	300	1,120	1,300	510	410	4,050	450	370	930	710
Washington	11,640	370	790	980	480	440	3,110	440	330	760	770
West Virginia	4,670	100	270	440	150	120	1,480	190	110	220	130
Wisconsin	11,310	270	690	900	490	330	2,940	410	290	720	600
Wyoming	1,000	†	60	110	†	†	260	50	†	70	†
United States	569,490	13,140	39,840	51,370	21,840	18,910	157,300	20,210	13,850	36,800	32,050

*Rounded to nearest 10. †Estimate is fewer than 50 deaths.

Note: State estimates may not add to US total due to rounding and exclusion of state estimates fewer than 50 deaths.

Source: US Mortality Data, 1969 to 2007, National Center for Health Statistics, Centers for Disease Control and Prevention, 2010.

Cancer Incidence Rates* by Site and State, US, 2002-2006

State	All Sites		Breast	Colon & Rectum		Lung & Bronchus		Non-Hodgkin Lymphoma		Prostate	Urinary Bladder	
	Male	Female	Female	Male	Female	Male	Female	Male	Female	Male	Male	Female
Alabama†	561.2	379.6	114.6	61.7	42.0	107.8	52.9	20.5	13.8	154.2	31.8	7.6
Alaska	529.4	417.7	126.4	60.0	45.6	84.6	64.3	22.6	17.6	141.4	41.6	7.3
Arizona‡	465.9	364.0	108.8	48.9	36.0	69.6	49.1	18.9	13.5	118.9	35.3	8.9
Arkansas	562.8	383.5	113.1	58.8	42.7	111.3	59.5	21.8	15.6	161.3	33.0	8.6
California	510.1	393.3	122.3	52.2	39.2	65.1	47.0	22.4	15.5	149.0	34.0	8.2
Colorado	501.5	394.1	123.1	50.0	39.5	60.5	45.2	21.0	16.2	156.4	33.6	8.8
Connecticut	591.0	455.5	135.0	62.8	46.5	81.8	60.1	25.8	18.1	164.6	45.4	12.6
Delaware	607.7	440.8	123.9	62.0	44.8	97.6	70.0	23.5	16.1	179.9	42.8	11.1
Dist. of Columbia‡	556.0	412.1	132.7	57.4	46.3	81.4	46.6	22.8	13.7	175.2	24.0	8.3
Florida	537.3	404.2	114.1	55.2	41.7	89.2	60.3	21.6	15.4	138.4	37.4	9.7
Georgia	566.4	392.4	118.5	58.7	42.3	101.7	53.3	20.8	14.1	162.4	32.7	8.0
Hawaii	486.7	383.0	121.4	61.3	41.5	68.8	40.1	19.0	12.6	128.6	26.2	6.2
Idaho	538.4	401.7	117.5	49.9	38.0	68.7	48.3	21.4	17.2	165.8	37.0	8.8
Illinois	579.8	429.1	123.1	67.2	48.3	92.3	58.8	24.1	16.2	157.9	40.7	10.5
Indiana	551.3	415.1	115.3	62.8	46.4	103.6	63.3	22.8	16.4	135.9	37.4	9.4
Iowa	558.9	429.2	124.0	64.4	49.6	89.9	53.1	24.4	17.6	144.9	40.7	9.6
Kansas	557.2	417.2	126.1	61.3	43.6	87.6	53.2	24.1	18.0	159.6	36.2	8.5
Kentucky	608.4	446.4	119.8	68.0	49.8	133.1	76.9	23.1	16.9	142.5	39.0	9.9
Louisiana†	619.2	409.6	119.6	68.5	47.3	109.5	57.9	23.2	16.7	176.8	35.2	8.6
Maine	620.9	465.8	128.6	65.9	48.8	99.2	66.0	24.5	19.2	164.8	49.4	13.4
Maryland§	—	—	—	—	—	—	—	—	—	—	—	—
Massachusetts	591.8	452.9	132.2	63.9	45.7	83.7	62.4	23.4	16.5	164.6	46.7	12.9
Michigan	597.5	437.9	124.2	58.8	44.6	93.0	61.5	25.2	18.7	179.4	41.9	10.5
Minnesota	567.2	416.4	126.4	56.4	42.3	69.8	49.5	26.4	17.7	184.6	40.1	10.3
Mississippi†‡	574.7	382.1	108.2	64.5	46.3	111.7	54.5	20.9	13.5	166.7	29.6	7.5
Missouri	544.3	417.2	121.9	62.3	44.9	105.2	63.4	21.8	15.5	129.3	35.8	8.9
Montana	541.9	406.3	119.6	52.5	40.3	75.3	57.4	22.8	14.9	174.5	40.8	9.1
Nebraska	561.8	418.2	126.4	67.6	47.5	84.6	49.3	24.7	17.4	157.6	37.2	9.5
Nevada	531.2	412.0	112.1	55.2	43.4	83.3	69.0	22.2	15.3	144.2	40.7	11.0
New Hampshire	584.3	455.3	131.2	59.0	44.5	82.1	62.7	23.5	18.2	159.5	48.0	13.4
New Jersey	603.9	449.5	128.0	65.4	48.0	79.6	56.0	25.6	17.7	177.9	46.2	12.2
New Mexico	480.5	366.1	109.6	49.4	35.8	57.5	39.0	17.9	14.3	146.1	26.7	7.0
New York	577.5	434.4	124.5	60.8	45.8	79.4	54.1	24.7	17.3	166.3	42.3	11.1
North Carolina	553.4	398.1	120.3	57.2	41.6	101.3	56.0	21.2	15.1	153.2	34.9	8.8
North Dakota	549.3	402.7	122.8	66.6	43.1	74.6	48.0	22.7	15.8	169.5	39.6	10.0
Ohio§	—	—	—	—	—	—	—	—	—	—	—	—
Oklahoma	561.4	422.2	127.2	60.1	43.7	105.6	65.1	22.9	17.5	150.0	34.9	8.6
Oregon	529.3	429.7	131.9	52.8	41.1	79.4	60.4	24.4	17.0	148.0	39.2	10.0
Pennsylvania	592.7	444.6	124.5	66.1	48.3	91.0	56.4	25.1	17.5	159.7	44.8	11.2
Rhode Island	608.9	455.3	128.3	65.7	46.2	92.2	62.2	24.8	17.5	152.2	53.1	13.0
South Carolina	587.4	397.5	119.2	61.2	44.1	102.2	53.0	20.7	14.6	171.5	32.4	7.8
South Dakota	547.8	395.3	119.6	60.2	44.5	78.7	46.3	22.1	17.0	171.0	39.1	8.1
Tennessee†¶	548.3	400.6	116.4	58.4	43.2	113.6	60.6	21.6	15.8	132.7	34.0	8.3
Texas†	539.6	389.9	114.9	57.5	39.7	88.3	51.2	22.3	16.1	144.0	30.2	7.3
Utah	486.8	346.6	110.0	45.3	33.7	37.8	23.0	22.4	16.3	182.2	28.3	6.1
Vermont§	—	—	—	—	—	—	—	—	—	—	—	—
Virginia	529.5	385.8	120.7	55.5	41.8	88.5	53.6	20.6	13.4	155.0	33.3	8.4
Washington	566.9	443.3	134.8	52.6	40.1	78.7	59.5	27.2	18.3	165.3	41.3	10.2
West Virginia	578.6	437.1	114.7	69.5	50.7	117.7	70.1	22.9	16.8	138.6	39.8	11.4
Wisconsin§	—	—	—	—	—	—	—	—	—	—	—	—
Wyoming	516.5	392.9	117.8	52.0	43.0	62.1	47.7	21.4	15.8	168.0	42.1	10.0
United States	556.5	414.8	121.8	59.0	43.6	86.4	55.5	23.1	16.3	155.5	37.9	9.6

* Per 100,000, age adjusted to the 2000 US standard population. † Due to the effect of large migrations of populations on this state as a result of Hurricane Katrina in September 2005, rates exclude cases diagnosed from July-December, 2005. ‡ This state's registry did not achieve high-quality data standards for one or more years during 2002-2006 according to the North American Association of Central Cancer Registry (NAACCR) data quality indicators. § This state's registry did not submit incidence data to NAACCR for 2002-2006. ¶ Case ascertainment for this state's registry is incomplete for the years 2002-2006.

Source: NAACCR, 2009. Data are collected by cancer registries participating in the National Cancer Institute's SEER program and the Centers for Disease Control and Prevention's National Program of Cancer Registries.

American Cancer Society, Surveillance and Health Policy Research, 2010

Cancer Death Rates* by Site and State, US, 2002-2006

	All Sites		Breast	Colon & Rectum		Lung & Bronchus		Non-Hodgkin Lymphoma		Pancreas		Prostate
State	Male	Female	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male
Alabama	267.7	161.5	25.1	24.2	15.2	93.4	41.7	8.8	5.8	12.7	8.9	31.2
Alaska	217.0	155.2	21.7	19.7	14.1	63.6	43.4	8.0	5.3	12.2	9.1	24.2
Arizona	196.9	138.4	21.8	19.0	12.9	56.4	36.3	8.1	5.4	10.6	7.8	22.1
Arkansas	261.6	165.2	24.3	24.0	16.1	96.9	47.6	9.3	5.3	12.6	9.1	27.5
California	202.2	147.6	23.2	19.2	13.9	53.0	35.3	8.5	5.3	11.5	9.2	24.2
Colorado	196.0	142.3	22.2	19.8	14.5	49.7	33.2	8.5	5.2	11.1	8.8	25.5
Connecticut	223.4	156.8	24.4	20.1	14.9	61.2	40.1	9.1	5.5	13.9	10.1	26.6
Delaware	246.0	165.8	24.0	23.2	15.5	78.6	48.5	9.1	5.3	11.5	8.8	26.8
Dist. of Columbia	270.2	164.3	28.9	26.2	17.5	74.3	35.0	9.6	4.0	14.9	10.2	43.3
Florida	215.2	147.9	22.6	19.5	13.9	68.3	41.2	8.6	5.4	11.6	8.5	21.3
Georgia	245.9	155.1	24.5	22.2	15.1	84.1	39.5	8.3	5.2	12.3	9.1	29.7
Hawaii	186.2	122.4	17.7	20.1	11.7	50.5	26.4	7.1	4.5	11.8	9.6	17.4
Idaho	205.5	146.2	22.3	17.6	13.4	54.6	35.1	8.6	5.8	11.3	10.3	28.2
Illinois	240.5	165.3	25.7	24.9	16.8	72.6	42.0	9.4	6.0	13.2	9.9	27.0
Indiana	253.0	170.1	24.8	24.9	16.3	85.3	48.0	10.1	6.2	13.1	9.6	26.2
Iowa	229.1	154.6	22.9	23.0	16.1	72.1	38.1	10.0	6.3	11.7	9.3	26.7
Kansas	227.1	156.5	24.6	22.0	15.7	72.7	41.8	9.7	6.1	12.5	9.2	23.5
Kentucky	280.7	178.7	24.8	26.2	18.2	107.6	56.4	9.8	6.0	12.4	9.3	26.6
Louisiana	278.6	175.8	28.9	27.6	17.5	92.9	46.1	9.7	6.4	13.8	10.8	30.4
Maine	251.3	172.4	23.4	21.9	16.3	79.2	49.4	9.3	6.1	12.9	10.1	26.2
Maryland	236.8	165.3	26.8	23.3	16.3	71.5	43.8	8.7	5.2	12.9	10.3	28.4
Massachusetts	235.4	163.5	24.2	22.3	15.9	67.0	44.2	9.3	6.1	13.5	9.9	25.5
Michigan	236.2	164.9	25.1	21.9	15.7	73.5	43.9	10.0	6.6	12.9	9.5	24.8
Minnesota	215.4	151.7	22.2	19.3	14.4	58.7	37.3	9.9	5.8	11.7	9.2	26.8
Mississippi	280.1	166.0	26.4	25.0	17.5	100.2	43.7	8.7	5.1	13.2	10.2	34.2
Missouri	249.4	167.1	26.3	23.3	16.2	86.0	46.6	9.2	5.9	12.7	9.2	24.0
Montana	214.9	160.0	23.1	19.8	14.5	61.7	43.0	8.8	5.8	11.9	8.7	28.4
Nebraska	220.5	149.7	22.9	24.0	16.3	65.8	35.5	9.1	6.2	11.9	8.1	24.5
Nevada	223.3	168.2	24.4	23.1	16.5	66.1	51.2	7.1	5.4	12.3	9.4	25.4
New Hampshire	233.2	163.1	23.3	22.0	15.1	66.9	44.7	9.2	6.2	11.6	10.8	27.2
New Jersey	226.7	166.2	27.4	24.1	17.2	62.7	40.1	9.5	5.8	12.7	10.0	24.5
New Mexico	199.2	140.2	22.5	19.9	13.6	47.3	29.7	7.5	5.0	11.3	9.2	26.3
New York	211.7	153.9	24.7	22.1	15.8	59.5	37.2	8.3	5.4	12.4	9.7	24.6
North Carolina	248.3	158.9	25.1	21.6	14.9	83.7	41.8	8.6	5.7	13.0	9.3	28.9
North Dakota	214.1	149.3	23.0	21.7	16.1	60.5	34.2	8.5	5.7	11.7	9.1	27.9
Ohio	251.9	170.2	27.1	24.2	17.1	81.5	45.5	9.7	6.0	12.5	9.4	27.0
Oklahoma	247.6	163.7	25.1	23.5	15.4	85.9	46.9	9.6	5.6	11.8	8.5	24.1
Oregon	223.2	165.5	23.9	19.5	14.8	65.7	46.8	9.7	6.5	12.4	9.8	26.9
Pennsylvania	243.2	166.3	26.4	24.6	16.5	72.4	40.7	9.9	6.2	13.2	9.7	26.0
Rhode Island	240.4	161.2	23.1	22.3	15.5	70.5	42.6	9.3	5.6	11.8	9.3	25.5
South Carolina	256.2	158.3	25.0	22.6	15.6	86.2	40.5	8.3	5.5	12.3	9.5	30.6
South Dakota	221.8	148.1	22.9	21.7	15.1	65.4	36.9	8.6	5.3	11.3	9.6	27.4
Tennessee	268.0	169.5	25.9	23.7	15.9	97.8	47.4	9.7	6.2	12.7	9.4	28.3
Texas	227.3	150.3	23.4	21.5	14.3	70.8	38.3	8.5	5.6	11.7	8.7	24.3
Utah	167.0	118.7	23.8	15.5	11.7	32.8	17.6	8.4	5.1	10.8	7.9	26.0
Vermont	216.2	155.1	22.9	22.1	15.7	60.7	40.7	9.2	5.5	10.7	8.2	26.2
Virginia	241.4	159.9	26.0	22.6	15.2	76.4	42.2	8.3	5.5	12.7	9.6	28.9
Washington	217.3	160.2	23.3	18.7	13.9	63.6	44.4	9.7	6.0	12.0	9.6	26.1
West Virginia	263.1	175.9	24.4	26.0	18.1	92.8	50.4	10.1	6.3	10.9	8.0	23.9
Wisconsin	226.3	156.6	23.4	20.7	14.5	62.9	38.7	9.4	6.1	12.7	9.7	27.8
Wyoming	206.7	154.4	22.6	18.7	17.1	57.3	38.1	8.0	7.3	12.1	9.9	24.1
United States	229.9	157.8	24.5	21.9	15.4	70.5	40.9	9.0	5.7	12.3	9.3	25.6

* Per 100,000, age adjusted to the 2000 US standard population.

Source: US Mortality Data 2002-2006, National Center for Health Statistics, Centers for Disease Control and Prevention, 2009.

American Cancer Society, Surveillance and Health Policy Research, 2010

Selected Cancers

Breast

New Cases: An estimated 207,090 new cases of invasive breast cancer are expected to occur among women in the US during 2010; about 1,970 new cases are expected in men. Excluding cancers of the skin, breast cancer is the most frequently diagnosed cancer in women. After increasing from 1994 to 1999, female breast cancer incidence rates decreased from 1999 to 2006 by 2.0% per year. This decrease may reflect reductions in the use of menopausal hormone therapy (MHT), previously known as hormone replacement therapy, following the publication of results from the Women's Health Initiative in 2002, which linked combined estrogen plus progestin MHT use to increased risk of coronary heart disease and breast cancer. It might also reflect a slight drop in mammography utilization during that time period, which could delay the diagnosis of some tumors. According to the National Health Interview Survey, mammography rates in women 40 and older decreased from 70.1% in 2000 to 66.4% in 2005.

In addition to invasive breast cancer, 54,010 new cases of in situ breast cancer are expected to occur among women in 2010. Of these, approximately 85% will be ductal carcinoma in situ (DCIS). Since 1998, in situ breast cancer incidence rates have been stable in white women and increasing in African American women.

Deaths: An estimated 40,230 breast cancer deaths (39,840 women, 390 men) are expected in 2010. Breast cancer ranks second as a cause of cancer death in women (after lung cancer). Death rates for breast cancer have steadily decreased in women since 1990, with larger decreases in women younger than 50 (a decrease of 3.2% per year) than in those 50 and older (2.0% per year). The decrease in breast cancer death rates represents progress due to earlier detection, improved treatment, and in the more recent time period, decreased incidence.

Signs and symptoms: The earliest sign of breast cancer is often an abnormality detected on a mammogram, before it can be felt by the woman or a health care professional. Larger tumors may become evident as a painless mass. Less common symptoms include persistent changes to the breast, such as thickening, swelling, distortion, tenderness, skin irritation, redness, scaliness, or nipple abnormalities, such as ulceration, retraction, or spontaneous discharge. Typically, breast pain results from benign conditions and is not an early symptom of breast cancer.

Risk factors: Aside from being female, age is the most important risk factor for breast cancer. Potentially modifiable risk factors include weight gain after age 18, being overweight or obese (for postmenopausal breast cancer), use of combined estrogen and progestin MHT, physical inactivity, and consumption of one or more alcoholic beverages per day. Medical findings that predict higher risk include high breast tissue density (a mammographic measure of the amount of glandular tissue relative to fatty tissue in the breast), high bone mineral density (routinely measured to identify women at increased risk for osteoporosis), and biopsy-confirmed hyperplasia (especially atypical hyperplasia). High-dose radiation to the chest, typically related to cancer treatment, also increases risk. Reproductive factors that increase risk include a long menstrual history (menstrual periods that start early and/or end late in life), recent use of oral contraceptives, never having children, and having one's first child after age 30.

Risk is also increased by a personal or family history of breast cancer and inherited genetic mutations in the breast cancer susceptibility genes BRCA1 and BRCA2. Although these mutations account for approximately 5%-10% of all breast cancer cases, they are very rare in the general population (less than 1%), so widespread genetic testing is not recommended. Some population groups, such as individuals of Ashkenazi Jewish descent, have an increased prevalence of BRCA1 and BRCA2 mutation carriers. Women with a strong family history of breast and/or ovarian cancer should be offered counseling to determine if genetic testing is appropriate. Studies suggest that prophylactic removal of the ovaries and/or breasts in BRCA1 and BRCA2 mutation carriers decreases the risk of breast cancer considerably, although not all women who choose this surgery would have developed breast cancer. Women who consider these options should undergo counseling before reaching a decision. Men with family members who are BRCA gene mutation carriers are also at risk for these mutations, and male BRCA 2 mutation carriers are at particularly increased risk for breast cancer.

Modifiable factors that are associated with a lower risk of breast cancer include breastfeeding, moderate or vigorous physical activity, and maintaining a healthy body weight. Two medications, tamoxifen and raloxifene, have been approved to reduce breast cancer risk in women at high risk. Raloxifene appears to have a lower risk of side effects, such as uterine cancer and blood clots. In women with estrogen-receptor positive breast cancer, additional treatment with tamoxifen reduces the risk of second breast cancers by about half.

Research is ongoing to identify additional modifiable risk factors for breast cancer. The International Agency for Research on Cancer recently concluded that there is limited evidence that tobacco smoking causes breast cancer. There is also some evidence that shift work, particularly at night, is associated with an increased risk of breast cancer.

Early detection: Mammography can detect breast cancer at an early stage, when treatment is more effective and a cure is more likely. Numerous studies have shown that early detection saves lives and increases treatment options. Steady declines in breast

Leading Sites of New Cancer Cases and Deaths – 2010 Estimates

Estimated New Cases*		Estimated Deaths	
Male	**Female**	**Male**	**Female**
Prostate 217,730 (28%)	Breast 207,090 (28%)	Lung & bronchus 86,220 (29%)	Lung & bronchus 71,080 (26%)
Lung & bronchus 116,750 (15%)	Lung & bronchus 105,770 (14%)	Prostate 32,050 (11%)	Breast 39,840 (15%)
Colon & rectum 72,090 (9%)	Colon & rectum 70,480 (10%)	Colon & rectum 26,580 (9%)	Colon & rectum 24,790 (9%)
Urinary bladder 52,760 (7%)	Uterine corpus 43,470 (6%)	Pancreas 18,770 (6%)	Pancreas 18,030 (7%)
Melanoma of the skin 38,870 (5%)	Thyroid 33,930 (5%)	Liver & intrahepatic bile duct 12,720 (4%)	Ovary 13,850 (5%)
Non-Hodgkin lymphoma 35,380 (4%)	Non-Hodgkin lymphoma 30,160 (4%)	Leukemia 12,660 (4%)	Non-Hodgkin lymphoma 9,500 (4%)
Kidney & renal pelvis 35,370 (4%)	Melanoma of the skin 29,260 (4%)	Esophagus 11,650 (4%)	Leukemia 9,180 (3%)
Oral cavity & pharynx 25,420 (3%)	Kidney & renal pelvis 22,870 (3%)	Non-Hodgkin lymphoma 10,710 (4%)	Uterine corpus 7,950 (3%)
Leukemia 24,690 (3%)	Ovary 21,880 (3%)	Urinary bladder 10,410 (3%)	Liver & intrahepatic bile duct 6,190 (2%)
Pancreas 21,370 (3%)	Pancreas 21,770 (3%)	Kidney & renal pelvis 8,210 (3%)	Brain & other nervous system 5,720 (2%)
All sites 789,620 (100%)	All sites 739,940 (100%)	All sites 299,200 (100%)	All sites 270,290 (100%)

*Excludes basal and squamous cell skin cancers and in situ carcinoma except urinary bladder.

cancer mortality among women since 1990 have been attributed to a combination of early detection and improvements in treatment. Mammography is a very accurate screening tool, both for women at average and increased risk; however, like most medical tests, it is not perfect. On average, mammography will detect about 80%-90% of breast cancers in women without symptoms. All suspicious abnormalities should be biopsied for a definitive diagnosis. Annual screening using magnetic resonance imaging (MRI) in addition to mammography is recommended for women at high lifetime risk of breast cancer starting at age 30. (For more information, see Saslow et al. *CA Cancer J Clin* 2007; 57:75-89.) Concerted efforts should be made to improve access to health care and to encourage all women 40 and older to receive regular mammograms.

Treatment: Taking into account tumor size, stage, and other characteristics, as well as patient preference, treatment may involve lumpectomy (surgical removal of the tumor with clear margins) or mastectomy (surgical removal of the breast). Removal of some of the axillary (underarm) lymph nodes is usually also recommended to obtain accurate information on the stage of disease. Treatment may also involve radiation therapy, chemotherapy (before or after surgery), hormone therapy (tamoxifen, aromatase inhibitors), or targeted therapy. Postmenopausal women with breast cancer that tests positive for hormone receptors benefit from treatment with an aromatase inhibitor, either after, or instead of, tamoxifen. For women whose cancer tests positive for HER2/neu, approved targeted therapies include trastuzumab (Herceptin) and, for advanced disease, lapatinib (Tykerb). The US Food and Drug Administration (FDA) approved bevacizumab (Avastin) for advanced breast cancer in 2008. Avastin slows tumor growth in women whose cancer has metastasized by blocking growth of new vessels that increase blood supply to the tumor, but it has not yet been shown to increase overall survival.

Numerous studies have shown that long-term survival rates after lumpectomy plus radiation therapy are similar to survival rates after mastectomy for women whose cancer has not spread to the skin, chest wall, or distant organs. Similarly, sentinel lymph node (the first lymph nodes to which cancer is likely to spread) biopsy is as effective and less damaging than full axillary node dissection in determining whether the tumor has spread beyond the breast in women with early stage disease. Women who elect to have sentinel lymph node biopsy should have their breast cancer surgery performed by a medical care team that is experienced with the technique. For women undergoing mastectomy, significant advances in reconstruction techniques provide several options for breast reconstruction, including the timing of the procedure (i.e., during mastectomy or in the time period following the procedure).

It is recommended that all patients with ductal carcinoma in situ (DCIS) be treated to avoid the potential development of invasive cancer. Treatment options for DCIS include lumpectomy with radiation therapy or mastectomy; either of these options may be followed by treatment with tamoxifen. Removal of axillary lymph nodes is not generally needed. A recent report by a panel of experts convened by the National Institutes of Health concluded that in light of the noninvasive nature and favorable prognosis of DCIS, the primary goal for future research is the ability to accurately group patients into risk categories that will allow the most successful outcomes with minimal necessary treatment.

Survival: The 5-year relative survival for female breast cancer patients has improved from 63% in the early 1960s to 90% today. The survival rate for women diagnosed with localized breast cancer (cancer that has not spread to lymph nodes or other locations outside the breast) is 98%. If the cancer has spread to nearby (regional stage) or distant (distant stage) lymph nodes or organs, the 5-year survival is 84% or 23%, respectively. Relative survival continues to decline after 5 years; for all stages combined, rates at 10 and 15 years after diagnosis are 82% and 75%, respectively. Caution should be used when interpreting long-term survival rates since they represent patients who were diagnosed and treated up to 22 years ago. Improvements in diagnosis and treatment may result in a better outlook for more recently diagnosed patients.

Many studies have shown that being overweight adversely affects survival for postmenopausal women with breast cancer and that women who are more physically active are less likely to die from the disease than women who are inactive. For more information about breast cancer, see the American Cancer Society's *Breast Cancer Facts & Figures 2009-2010* (8610.09), available online at cancer.org.

Childhood Cancer

New cases: An estimated 10,700 new cases are expected to occur among children aged 0 to 14 years in 2010. Childhood cancers are rare, representing less than 1% of all new cancer diagnoses.

Deaths: An estimated 1,340 deaths are expected to occur among children aged 0 to 14 years in 2010, about one-third of these from leukemia. Although uncommon, cancer is the second leading cause of death in children, exceeded only by accidents. Mortality rates for childhood cancer have declined by 55% since 1975. The substantial progress in childhood cancer survival rates is largely attributable to improvements in treatment and the high proportion of patients participating in clinical trials.

Early detection: Early symptoms are usually nonspecific. Parents should ensure that children have regular medical checkups and should be alert to any unusual symptoms that persist. Symptoms of childhood cancer include an unusual mass or swelling; unexplained paleness or loss of energy; sudden tendency to bruise; a persistent, localized pain; prolonged, unexplained fever or illness; frequent headaches, often with vomiting; sudden eye or vision changes; and excessive, rapid weight loss. According to the International Classification of Childhood Cancer, childhood cancers include:

- Leukemia (31.0% of all childhood cancers), which may be recognized by bone and joint pain, weakness, bleeding, and fever
- Brain and other nervous system (21.3%), which in early stages may cause headaches, nausea, vomiting, blurred or double vision, dizziness, and difficulty in walking or handling objects
- Neuroblastoma (7.1%), a cancer of the sympathetic nervous system that usually appears as a swelling in the abdomen
- Wilms tumor (5.2%), a kidney cancer that may be recognized by a swelling or lump in the abdomen
- Non-Hodgkin lymphoma (4.3%) and Hodgkin lymphoma (3.8%), which affect lymph nodes but may spread to bone marrow and other organs, and may cause swelling of lymph nodes in the neck, armpit, or groin; weakness; and fever
- Rhabdomyosarcoma (3.3%), a soft tissue sarcoma that can occur in the head and neck, genitourinary area, trunk, and extremities, and may cause pain and/or a mass or swelling
- Retinoblastoma (2.6%), an eye cancer that is typically recognized because of discoloration of the eye pupil and usually occurs in children younger than 4 years
- Osteosarcoma (2.5%), a bone cancer that most commonly appears as sporadic pain in the affected bone that may worsen at night or with activity, with eventual progression to local swelling; most often occurs in adolescents
- Ewing sarcoma (1.6%), another type of cancer that usually arises in bone, appears as pain at the tumor site, and most often occurs in adolescents

(Proportions are provided for all races combined and may vary according to race/ethnicity.)

Treatment: Childhood cancers can be treated by a combination of therapies (surgery, radiation, and chemotherapy) chosen based on the type and stage of cancer. Treatment is coordinated by a team of experts, including pediatric oncologists, pediatric nurses, social workers, psychologists, and others who assist children and their families. Because these cancers are uncommon, outcomes are more successful when treatment is managed by a children's cancer center. If the child is eligible, placement in a clinical trial, which compares the best current treatment to new treatment, should also be considered.

Survival: For all childhood cancers combined, the 5-year relative survival has improved markedly over the past 30 years, from less than 50% before the 1970s to 80% today, due to new and improved treatments. However, rates vary considerably, depending on cancer type; moreover, within the major catego-

ries, cancer subtypes may vary in response to treatment and/or survival characteristics. For the most recent time period (1999-2005), the 5-year survival for rhabdomyosarcoma is 66%; osteosarcoma, 69%; brain and other nervous system, 71%; neuroblastoma, 74%; leukemia, 82%; non-Hodgkin lymphoma, 85%; Wilms tumor, 88%; and Hodgkin lymphoma, 94%. Survivors of childhood cancer may experience treatment-related side effects. Late treatment effects include organ malfunction, secondary cancers, and cognitive impairments. The Children's Oncology Group (COG) has developed long-term follow-up guidelines for screening and management of late effects in survivors of childhood cancer. For more information on childhood cancer management, see the COG Web site at survivorshipguidelines.org. The Childhood Cancer Survivor Study, which has followed more than 14,000 long-term childhood cancer survivors, has also provided important and valuable new information about the late effects of cancer treatment; for more information, visit ccss.stjude.org/.

Colon and Rectum

New cases: An estimated 102,900 cases of colon and 39,670 cases of rectal cancer are expected to occur in 2010. Colorectal cancer is the third most common cancer in both men and women. Colorectal cancer incidence rates have been decreasing for most of the past two decades (from 66.3 cases per 100,000 persons in 1985 to 45.5 cases in 2006). The decline accelerated from 1998 to 2006 (3.0% per year in men and 2.2% per year in women), which has largely been attributed to increases in the use of colorectal cancer screening tests that allow the detection and removal of colorectal polyps before they progress to cancer. In contrast to the overall declines, among adults younger than 50 years, for whom screening is not recommended for those at average risk, colorectal cancer incidence rates have been increasing by about 2% per year since 1994 in both men and women.

Deaths: An estimated 51,370 deaths from colorectal cancer are expected to occur in 2010, accounting for 9% of all cancer deaths. Mortality rates for colorectal cancer have declined in both men and women over the past two decades, with steeper declines in the most recent time period (3.9% per year from 2002 to 2006 in men and 3.4% per year from 2001 to 2006 in women). This decrease reflects declining incidence rates and improvements in early detection and treatment.

Signs and symptoms: Early stage colorectal cancer does not usually have symptoms; therefore, screening is often necessary to detect colorectal cancer in its early stages. Advanced disease may cause rectal bleeding, blood in the stool, a change in bowel habits, and cramping pain in the lower abdomen. In some cases, blood loss from the cancer leads to anemia (low red blood cells), causing symptoms such as weakness and excessive fatigue. Due to an increase in colorectal cancer incidence in younger adults in recent years, timely evaluation of symptoms consistent with colorectal cancer in adults under age 50 is especially important.

Risk factors: The risk of colorectal cancer increases with age; 91% of cases are diagnosed in individuals aged 50 and older. Several modifiable factors are associated with increased risk of colorectal cancer. Among these are obesity, physical inactivity, a diet high in red or processed meat, heavy alcohol consumption, long-term smoking, and possibly inadequate intake of fruits and vegetables. Consumption of milk and calcium appears to decrease risk. Studies suggest that regular use of nonsteroidal anti-inflammatory drugs, such as aspirin, and menopausal hormone therapy may also reduce colorectal cancer risk. However, these drugs are not currently recommended for the prevention of colorectal cancer because they can have serious adverse health effects.

Colorectal cancer risk is also increased by certain inherited genetic mutations (familial adenomatous polyposis [FAP] and hereditary non-polyposis colorectal cancer [HNPCC], also known as Lynch syndrome), a personal or family history of colorectal cancer and/or polyps, or a personal history of chronic inflammatory bowel disease. Studies have also found an association between diabetes and colorectal cancer.

Early detection: Beginning at age 50, men and women who are at average risk for developing colorectal cancer should begin screening. Screening can result in the detection and removal of colorectal polyps before they become cancerous, as well as the detection of cancer that is at an early stage. Thus, colorectal cancer screening reduces mortality both by decreasing the incidence of cancer and by detecting cancers at early, more treatable stages. The American Cancer Society collaborated with several other organizations to release updated colorectal cancer screening guidelines in March 2008. These joint guidelines emphasize cancer prevention and draw a distinction between colorectal screening tests that primarily detect cancer and those that can detect both cancer and precancerous polyps. There are a number of recommended screening options that vary by the extent of bowel preparation, as well as test performance, limitations, time interval, and cost. For detailed information on colorectal cancer screening options, see *Colorectal Cancer Facts & Figures 2008-2010* on cancer.org. (See page 62 for the American Cancer Society's screening guidelines for colorectal cancer.)

Treatment: Surgery is the most common treatment for colorectal cancer. For cancers that have not spread, surgical removal may be curative. A permanent colostomy (creation of an abdominal opening for elimination of body wastes) is rarely needed for colon cancer and is infrequently required for rectal cancer. Chemotherapy alone, or in combination with radiation (for rectal cancer), is given before or after surgery to most patients whose cancer has penetrated the bowel wall deeply or spread to lymph nodes. Adjuvant chemotherapy (anticancer drugs in addition to surgery or radiation) for colon cancer in otherwise healthy patients aged 70 and older is equally effective and can be no more toxic than in younger patients. A chemotherapy combination referred to as FOLFOX (oxaliplatin, fluorouracil,

and leucovorin) is often used to treat persons with metastatic carcinoma of the colon or rectum. Three targeted monoclonal antibody therapies are approved by the FDA to treat metastatic colorectal cancer: bevacizumab (Avastin) blocks the growth of blood vessels to the tumor, and cetuximab (Erbitux) and panitumumab (Vectibix) both block the effects of hormone-like factors that promote cancer cell growth.

Survival: The 1- and 5-year relative survival for persons with colorectal cancer is 83% and 65%, respectively. Survival continues to decline beyond 5 years to 59% at 10 years after diagnosis. When colorectal cancers are detected at an early, localized stage, the 5-year survival is 91%; however, only 39% of colorectal cancers are diagnosed at this stage, in part due to underuse of screening. After the cancer has spread regionally to involve adjacent organs or lymph nodes, the 5-year survival drops to 70%. When the disease has spread to distant organs, the 5-year survival is 11%.

Kidney

New cases: An estimated 58,240 new cases of kidney (renal) cancer are expected to be diagnosed in 2010. Kidney cancer includes renal cell carcinoma (92%), renal pelvis carcinoma (7%), and Wilms tumor (1%), a childhood cancer that usually develops before age 5. (See Childhood Cancer, page 11, for information about Wilms tumor.) Incidence rates of kidney cancer have been increasing since 1975 by 1.8% per year in men and 2.4% per year in women, primarily due to increases in local stage disease.

Deaths: An estimated 13,040 deaths from kidney cancer are expected to occur in 2010. Death rates for kidney cancer have been decreasing in women by 0.6% per year since 1992 and in men by 1.5% per year since 2002.

Signs and symptoms: Early stage kidney cancer usually has no symptoms. Symptoms that may develop as the tumor progresses include blood in the urine, a pain or lump in the lower back or abdomen, fatigue, weight loss, fever, or swelling in the legs and ankles.

Risk factors: Tobacco use is a strong risk factor for kidney cancer, with the largest increased risk for cancer of the renal pelvis, particularly for heavy smokers. Additional risk factors for renal cell carcinoma include obesity, to which an estimated 30% of cases can be attributed, and hypertension (high blood pressure). A small proportion of renal cell cancers are the result of rare hereditary conditions, such as von Hippel-Lindau disease. The only established risk factor for cancer of the renal pelvis other than smoking is long-term use of phenacetin-containing pain-relievers. Phenacetin was used extensively in fever- and pain-reducing drugs until it was implicated in kidney disease and withdrawn from the US market in 1983.

Early detection: There are no reliable screening tests for people at average risk. Nevertheless, kidney cancers have been increasingly diagnosed as a result of the increased use of medical imaging technologies during the past two decades.

Treatment: Surgery (traditional or laparoscopic) is the primary treatment for most kidney cancers. Patients who are not prime surgical candidates may be offered ablation therapy, a procedure that destroys the tumor using heat or cold energy. Kidney tumors tend to be resistant to both traditional chemotherapy and radiation therapy. Until recently, immunotherapy (interferon-alpha and interleukin-2), which has intense side effects and generally modest survival benefits, was the main treatment option for late-stage disease. However, improved understanding of the biology of kidney cancer has led to the development of new targeted therapies that block the tumor's blood supply or target other parts of kidney cancer cells. Since 2005, six of these agents have been approved by the FDA for the treatment of metastatic disease: sorafenib (Bexavarm), sunitinib (Sutent), temsirolimus (Torisel), everolimus (Afinitor), bevacizumab (Avastin), and pazopanib (Votrient).

Survival: The 1- and 5-year relative survival rates for cancers of the kidney and renal pelvis are 82% and 68%, respectively. More than half of cases are diagnosed at the local stage, for which the 5-year relative survival rate is 90%. Five-year survival is lower for renal pelvis (51%) than for renal cell (70%) carcinoma.

Leukemia

New cases: An estimated 43,050 new cases of leukemia are expected in 2010, with slightly more cases of chronic (19,860) than acute (17,660) disease. Leukemia is diagnosed 10 times more often in adults than in children. Acute lymphocytic leukemia (ALL) accounts for approximately 74% of the leukemia cases among children ages 0 to 19 years. In adults, the most common types are acute myeloid leukemia (AML) and chronic lymphocytic leukemia (CLL). The incidence of AML increased by an average of 2.1% per year from 1988 to 2000, but has since been decreasing by 2.7% per year. In contrast, the incidence of CLL has remained relatively stable since 1975.

Deaths: An estimated 21,840 deaths are expected to occur in 2010. The decline in death rates among males and females combined has increased in recent years, from 0.5% per year between 1991 and 2001 to 1.3% per year between 2001 and 2006.

Signs and symptoms: Symptoms may include fatigue, paleness, weight loss, repeated infections, fever, bruising easily, and nosebleeds or other hemorrhages. In children, these signs can appear suddenly. Chronic leukemia can progress slowly with few symptoms and is often diagnosed during routine blood tests.

Risk factors: Exposure to ionizing radiation increases risk of several types of leukemia. Medical radiation, such as that used in cancer treatment, is a substantial source of radiation exposure. Leukemia may also occur as a side effect of chemotherapy. Children with Down syndrome and certain other genetic abnor-

Probability (%) of Developing Invasive Cancers Over Selected Age Intervals by Sex, US, 2004-2006*

		Birth to 39	40 to 59	60 to 69	70 and Older	Birth to Death
All sites†	Male	1.43 (1 in 70)	8.42 (1 in 12)	15.61 (1 in 6)	37.84 (1 in 3)	44.05 (1 in 2)
	Female	2.10 (1 in 48)	8.97 (1 in 11)	10.18 (1 in 10)	26.47 (1 in 4)	37.63 (1 in 3)
Urinary bladder‡	Male	0.02 (1 in 4,741)	0.39 (1 in 257)	0.95 (1 in 106)	3.66 (1 in 27)	3.81 (1 in 26)
	Female	0.01 (1 in 10,613)	0.12 (1 in 815)	0.26 (1 in 385)	1.01 (1 in 99)	1.18 (1 in 84)
Breast	Female	0.49 (1 in 206)	3.75 (1 in 27)	3.40 (1 in 29)	6.50 (1 in 15)	12.08 (1 in 8)
Colon & rectum	Male	0.08 (1 in 1,269)	0.91 (1 in 110)	1.48 (1 in 67)	4.50 (1 in 22)	5.39 (1 in 19)
	Female	0.08 (1 in 1,300)	0.72 (1 in 139)	1.07 (1 in 94)	4.09 (1 in 24)	5.03 (1 in 20)
Leukemia	Male	0.17 (1 in 603)	0.21 (1 in 475)	0.33 (1 in 299)	1.19 (1 in 84)	1.51 (1 in 66)
	Female	0.13 (1 in 798)	0.15 (1 in 690)	0.20 (1 in 504)	0.78 (1 in 128)	1.08 (1 in 92)
Lung & bronchus	Male	0.03 (1 in 3,461)	0.95 (1 in 105)	2.35 (1 in 43)	6.71 (1 in 15)	7.73 (1 in 13)
	Female	0.03 (1 in 3,066)	0.79 (1 in 126)	1.75 (1 in 57)	4.83 (1 in 21)	6.31 (1 in 16)
Melanoma of the skin§	Male	0.16 (1 in 638)	0.64 (1 in 155)	0.72 (1 in 138)	1.77 (1 in 56)	2.67 (1 in 37)
	Female	0.28 (1 in 360)	0.55 (1 in 183)	0.36 (1 in 274)	0.79 (1 in 126)	1.79 (1 in 56)
Non-Hodgkin lymphoma	Male	0.13 (1 in 782)	0.44 (1 in 225)	0.59 (1 in 171)	1.71 (1 in 58)	2.28 (1 in 44)
	Female	0.09 (1 in 1,172)	0.32 (1 in 315)	0.44 (1 in 227)	1.39 (1 in 72)	1.92 (1 in 52)
Prostate	Male	0.01 (1 in 9,422)	2.44 (1 in 41)	6.45 (1 in 16)	12.48 (1 in 8)	15.90 (1 in 6)
Uterine cervix	Female	0.15 (1 in 648)	0.27 (1 in 374)	0.13 (1 in 755)	0.19 (1 in 552)	0.69 (1 in 145)
Uterine corpus	Female	0.07 (1 in 1,453)	0.73 (1 in 136)	0.83 (1 in 121)	1.23 (1 in 81)	2.53 (1 in 40)

* For people free of cancer at beginning of age interval. Percentages and "1 in" numbers may not be equivalent due to rounding.

† All sites excludes basal and squamous cell skin cancers and in situ cancers except urinary bladder.

‡ Includes invasive and in situ cancer cases.

§ Statistic is for whites only.

Source: DevCan: Probability of Developing or Dying of Cancer Software, Version 6.4.1. Statistical Research and Applications Branch, National Cancer Institute, 2009. srab.cancer.gov/devcan.

American Cancer Society, Surveillance and Health Policy Research, 2010

malities have higher incidence rates of leukemia. Some recent studies suggest that obesity may also be associated with an increased risk of leukemia. Family history is one of the strongest risk factors for CLL. Cigarette smoking and exposure to certain chemicals such as benzene, a component in gasoline and cigarette smoke, are risk factors for myeloid leukemia. Infection with human T-cell leukemia virus type I (HTLV-I) can cause a rare type of CLL called adult T-cell leukemia/lymphoma. The prevalence of HTLV-I infection is geographically localized and is most common in southern Japan and the Caribbean; infected individuals in the US tend to be descendants or immigrants from endemic regions.

Early detection: Leukemia can be difficult to diagnose early because symptoms often resemble those of other, less serious conditions. When a physician does suspect leukemia, diagnosis can be made using blood tests and a bone marrow biopsy.

Treatment: Chemotherapy is the most effective method of treating leukemia. Various anticancer drugs are used, either in combination or as single agents. Imatinib (Gleevec) is a highly specific drug used for the treatment of chronic myeloid (or myelogenous) leukemia (CML), which will be diagnosed in about 4,870 people in 2010. Two related drugs, nilotinib (Tasigna) and dasatinib (Sprycel), are often effective if imatinib stops working. Imatinib is also sometimes used to treat ALL. Gemtuzumab ozogamicin (Mylotarg) is a targeted drug approved for treatment in older AML patients whose cancer has relapsed or who are not able to receive other chemotherapy. Recent clinical trials have shown that adults with AML who are treated with twice the conventional dose of daunorubicin experience higher and more rapid rates of remission. Ofatumumab (Arzerra) was recently approved for the treatment of CLL patients if other chemotherapeutic agents can no longer control the cancer. Antibiotics and transfusions of blood components are used as supportive treatments. Under appropriate conditions, stem cell transplantation may be useful in treating certain types of leukemia.

Survival: Survival in leukemia varies by type, ranging from a 5-year relative survival of 23% for people with AML to 79% for people with CLL. Advances in treatment have resulted in a dramatic improvement in survival for most types of leukemia. The 5-year relative survival rate increased for ALL, from 42% in 1975-1977 to 66% in 1999-2005, and for AML, from 7% in 1975-1977 to 23% in 1999-2005. Survival rates for children with ALL have increased from 58% to 89% over the same time period. In large part due to the discovery of the targeted cancer drug Gleevec, survival rates for CML have more than doubled since 1975-1977, from 24% to 53% today.

Liver

New Cases: An estimated 24,120 new cases of liver cancer (including intrahepatic bile duct) are expected to occur in the US during 2010. More than 80% of these cases are hepatocellular carcinoma (HCC), originating from hepatocytes, the predominant type of cell in the liver. The incidence of liver cancer has been steadily increasing since the early 1980s. Incidence rates are highest among Asian Americans/Pacific Islanders and Hispanics (page 39).

Deaths: An estimated 18,910 liver cancer deaths (6,190 women, 12,720 men) are expected in 2010. Similar to the incidence trend, death rates for liver cancer have continued to increase since the early 1980s. Incidence and mortality rates are more than twice as high in men as in women.

Signs and symptoms: Common symptoms include abdominal pain and/or swelling, weight loss, weakness, loss of appetite, jaundice (a yellowish discoloration of the skin and eyes), and fever. Enlargement of the liver is the most common physical sign, occurring in 50%-90% of patients.

Risk factors: In the US and other western countries, alcohol-related cirrhosis and possibly non-alcoholic fatty liver disease associated with obesity account for the majority of liver cancer cases. Chronic infections with hepatitis B virus (HBV) and hepatitis C virus (HCV) are associated with less than half of liver cancer cases in the US, although they are the major risk factors for the disease worldwide. In the US, rates of HCC are higher in immigrants from areas where HBV is endemic, such as China, Southeast Asia, and sub-Saharan Africa. Other risk factors for liver cancer, particularly in economically developing countries, include consumption of food contaminated with aflatoxin and parasitic infections (schistosomiasis and liver flukes). Aflatoxin is a toxin produced by mold during the storage of agricultural products in a warm, humid environment. Treatment of cirrhosis (a disease state that precedes liver cancer in the majority of cases) with interferon may reduce the risk of progression to cancer and is the subject of ongoing research.

A vaccine that protects against HBV has been available since 1982. The HBV vaccination is recommended for all infants at birth; for all children under 18 years who were not vaccinated at birth; and for adults in high-risk groups, including health care workers. It is also recommended that all pregnant women be tested for HBV. In contrast to HBV, no vaccine is available against HCV. The Centers for Disease Control and Prevention (CDC) recommends routine HCV testing for individuals at high risk so that infected individuals can receive counseling in order to reduce the risk of HCV transmission to others. Other preventive measures for HCV infection include screening of donated blood, organs, and tissues; instituting infection control practices during all medical, surgical, and dental procedures; and needle-exchange programs for injecting drug users. For more information on hepatitis infections, including who is at risk, visit the CDC Web site at cdc.gov/hepatitis/.

Early detection: Screening for liver cancer has not been proven to improve survival. Nonetheless, many doctors in the US screen high-risk persons (for example, those chronically infected with HBV or HCV) with ultrasound or blood tests. At present, the best strategy to reduce the burden of cancer is the adoption of preventive measures, including vaccination against HBV and the avoidance of high-risk behaviors such as intravenous drug use and alcohol abuse.

Treatment: Early stage liver cancer in patients with sufficient healthy liver tissue can sometimes be successfully treated with surgery or, less often, with liver transplantation. Fewer surgical options exist for patients diagnosed at an advanced stage of the disease, often because the portion of the liver not affected by cancer is damaged as well. Patients whose tumors cannot be surgically removed may choose ablation (tumor destruction) or embolization, a procedure that cuts off blood flow to the tumor. Sorafenib (Nexavar) is a drug approved for the treatment of HCC in patients who are not candidates for surgery.

Survival: The 5-year relative survival rate for patients with liver cancer is 14%. Five-year survival is 26% among patients in whom cancer is found at an early stage, compared to only 2% when it is found after spreading to distant organs.

Lung and Bronchus

New cases: An estimated 222,520 new cases of lung cancer are expected in 2010, accounting for about 15% of cancer diagnoses. The incidence rate is declining significantly in men, from a high of 102.1 cases per 100,000 in 1984 to 71.3 cases in 2006. In women, the rate is approaching a plateau after a long period of increase. Lung cancer is classified clinically as small cell (14%) or non-small cell (85%) for the purposes of treatment.

Deaths: Lung cancer accounts for more deaths than any other cancer in both men and women. An estimated 157,300 deaths, accounting for about 28% of all cancer deaths, are expected to occur in 2010. Since 1987, more women have died each year from lung cancer than from breast cancer. Death rates among men decreased by 1.3% per year from 1990 to 1994 and by 2.0% per year from 1994 to 2006. Female lung cancer death rates have been stable since 2003 after continuously increasing for several decades. These trends in lung cancer mortality reflect historical differences in cigarette smoking between men and women and the decrease in smoking rates over the past 40 years.

Signs and symptoms: Symptoms may include persistent cough, sputum streaked with blood, chest pain, voice change, and recurrent pneumonia or bronchitis.

Risk factors: Cigarette smoking is by far the most important risk factor for lung cancer. Risk increases with quantity and duration of cigarette consumption. Cigar and pipe smoking also increase risk. Other risk factors include occupational or environmental exposure to secondhand smoke, radon, asbestos (particularly among smokers), certain metals (chromium, cadmium, arsenic),

some organic chemicals, radiation, air pollution, and a history of tuberculosis. Genetic susceptibility plays a contributing role in the development of lung cancer, especially in those who develop the disease at a younger age.

Early detection: Screening for early lung cancer detection has not yet been proven to reduce mortality. Detection by chest x-ray, analysis of cells in sputum, and fiber-optic examination of the bronchial passages has shown limited effectiveness in reducing lung cancer deaths. Newer tests, such as low-dose spiral computed tomography (CT) scans and molecular markers in sputum, have produced promising results in detecting lung cancers at earlier, more operable stages in high-risk patients, but have not yet been shown to reduce lung cancer deaths. In addition, there are considerable risks associated with lung biopsy and surgery that must be considered when evaluating the risks and benefits of screening. The National Lung Screening Trial is a clinical trial to assess whether screening individuals at high risk for lung cancer with spiral CT or standard chest x-ray can prevent lung cancer deaths. Launched in 2002, the study represents a collaboration of the National Cancer Institute and the American College of Radiology Imaging Network. The American Cancer Society contributed to the recruitment of subjects for the trial. Results from the study are expected by 2010-2011.

Treatment: Treatment options are determined by the type (small cell or non-small cell) and stage of cancer and include surgery, radiation therapy, chemotherapy, and targeted therapies such as bevacizumab (Avastin) and erlotinib (Tarceva). For localized cancers, surgery is usually the treatment of choice. Recent pooled analyses confirm that survival for all patients with early stage, non-small cell lung cancer is improved by giving chemotherapy after surgery. Because the disease has usually spread by the time it is discovered, radiation therapy and chemotherapy are often used, sometimes in combination with surgery. A recent clinical trial showed a survival advantage for advanced-stage non-small cell lung cancer patients when cetuximab (Erbitux, a monoclonal antibody) was combined with the traditional chemotherapeutic regimen. Chemotherapy alone or combined with radiation is the usual treatment of choice for small cell lung cancer; on this regimen, a large percentage of patients experience remission, though the cancer often returns.

Survival: The 1-year relative survival for lung cancer increased from 35% in 1975-1979 to 42% in 2002-2005, largely due to improvements in surgical techniques and combined therapies. However, the 5-year survival rate for all stages combined is only 16%. The 5-year survival rate is 53% for cases detected when the disease is still localized, but only 15% of lung cancers are diagnosed at this early stage. The 5-year survival for small cell lung cancer (6%) is lower than that for non-small cell (17%).

Lymphoma

New cases: An estimated 74,030 new cases of lymphoma will occur in 2010, including 8,490 cases of Hodgkin lymphoma and 65,540 cases of non-Hodgkin lymphoma (NHL). NHL encompasses a wide variety of disease subtypes for which incidence patterns vary; overall incidence has been stable since 1991 in men, but has been increasing by 1.1% per year since 1990 in women. Rates for Hodgkin lymphoma have decreased slightly in men (0.6% per year), but increased slightly in women (0.4 % per year) over the past 30 years.

Deaths: An estimated 21,530 deaths from lymphoma will occur in 2010 (Hodgkin lymphoma, 1,320; non-Hodgkin lymphoma, 20,210). Death rates for Hodgkin lymphoma have been decreasing in both men and women for more than three decades, though the decrease in men has slowed since 2000. Death rates for NHL have been decreasing since 1997 by 3.0% per year in men and by 3.7% per year in women after increasing for most of the previous two decades.

Signs and symptoms: Symptoms may include swollen lymph nodes, itching, night sweats, fatigue, unexplained weight loss, and intermittent fever.

Risk factors: Like most cancers, the risk of developing NHL increases with age. In contrast, the risk of Hodgkin lymphoma is highest during adolescence and early adulthood. In most cases of lymphoma the cause is unknown, although various risk factors associated with altered immune function have been identified. Non-Hodgkin lymphoma risk is elevated in persons with organ transplants who receive immune suppressants to prevent transplant rejection; in people with severe autoimmune conditions; and in people infected with human immunodeficiency virus (HIV), human T-cell leukemia virus type I (HTLV-I), and probably hepatitis C virus (HCV). Epstein-Barr virus (EBV) causes Burkitt lymphoma, is associated with some types of Hodgkin lymphoma, and probably plays a role in some other NHLs. *H. pylori* infection increases the risk of gastric lymphoma. A family history of lymphoma and certain common genetic variations in immune response genes are associated with a modestly increased risk. Occupational exposures to herbicides, chlorinated organic compounds, and certain other chemicals are also associated with moderately increased risk.

Treatment: Hodgkin lymphoma is usually treated with chemotherapy, radiation therapy, bone marrow or stem cell transplantation, or any combination thereof, depending on stage and cell type of the disease. Non-Hodgkin lymphoma patients are usually treated with chemotherapy; radiation, alone or in combination with chemotherapy, is used less often. Highly specific monoclonal antibodies, such as rituximab (Rituxan) and alemtuzumab (Campath), directed at lymphoma cells are used for initial treatment and recurrence of some types of non-Hodgkin

Five-year Relative Survival Rates* (%) by Stage at Diagnosis, 1999-2005

	All Stages	Local	Regional	Distant		All Stages	Local	Regional	Distant
Breast (female)	89	98	84	23	Ovary	46	94	73	28
Colon & rectum	65	91	70	11	Pancreas	6	22	9	2
Esophagus	17	37	19	3	Prostate	100	100	100	31
Kidney†	68	90	62	10	Stomach	26	63	27	3
Larynx	62	78	42	32	Testis	95	99	96	71
Liver‡	13	26	9	2	Thyroid	97	100	97	59
Lung & bronchus	16	53	24	4	Urinary bladder	80	74	36	6
Melanoma of the skin	91	98	62	15	Uterine cervix	71	92	58	17
Oral cavity & pharynx	61	83	54	32	Uterine corpus	83	96	67	17

*Rates are adjusted for normal life expectancy and are based on cases diagnosed in the SEER 17 areas from 1999-2005, followed through 2006.
†Includes renal pelvis. ‡Includes intrahepatic bile duct.

Local: an invasive malignant cancer confined entirely to the organ of origin. **Regional:** a malignant cancer that 1) has extended beyond the limits of the organ of origin directly into surrounding organs or tissues; 2) involves regional lymph nodes by way of lymphatic system; or 3) has both regional extension and involvement of regional lymph nodes. **Distant:** a malignant cancer that has spread to parts of the body remote from the primary tumor either by direct extension or by discontinuous metastasis to distant organs, tissues, or via the lymphatic system to distant lymph nodes.

Source: Horner MJ, Ries LAG, Krapcho M, et al. (eds). *SEER Cancer Statistics Review, 1975-2006*, National Cancer Institute, Bethesda, MD, seer.cancer.gov/csr/1975_2006/, 2009.

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lymphoma, as are antibodies linked to a radioactive atom, such as ibritumomab tiuxetan (Zevalin) and tositumomab (Bexxar). High-dose chemotherapy with stem cell transplantation and low-dose chemotherapy with stem cell transplantation (called non-myeloablative) are options if non-Hodgkin lymphoma persists or recurs after standard treatment.

Survival: Survival varies widely by cell type and stage of disease. The 1-year relative survival for Hodgkin and non-Hodgkin lymphoma is 92% and 80%, respectively; the 5-year survival is 85% and 67%, respectively. Ten years after diagnosis, survival for Hodgkin and non-Hodgkin lymphoma declines to 81% and 56%, respectively.

Oral Cavity and Pharynx

New cases: An estimated 36,540 new cases of cancer of the oral cavity and pharynx are expected in 2010. Incidence rates are more than twice as high in men as in women. Incidence has been declining in men since 1975 and in women since 1980, although recent studies have shown that incidence is increasing for those cancers related to human papillomavirus (HPV) infection.

Deaths: An estimated 7,880 deaths from oral cavity and pharynx cancer are expected in 2010. Death rates have decreased by more than 2% per year since 1980 in men and since 1990 in women.

Signs and symptoms: Symptoms may include a sore in the throat or mouth that bleeds easily and does not heal, a lump or thickening, ear pain, a neck mass, coughing up blood, or a red or white patch that persists. Difficulties in chewing, swallowing, or moving the tongue or jaws are often late symptoms.

Risk factors: Known risk factors include all forms of smoked and smokeless tobacco products and excessive consumption of alcohol. Many studies have reported a synergism between smoking and alcohol use, resulting in more than a 30-fold increased risk in individuals who both smoke and drink heavily. HPV infection is associated with certain types of oropharyngeal cancer.

Early detection: Cancer can affect any part of the oral cavity, including the lip, tongue, mouth, and throat. Dentists and primary care physicians can detect premalignant abnormalities and cancer at an early stage, when they are most curable.

Treatment: Radiation therapy and surgery, separately or in combination, are standard treatments. In advanced disease, chemotherapy is added to surgery and/or radiation. Targeted therapy with cetuximab (Erbitux) may be combined with radiation in initial treatment or used alone to treat recurrent cancer.

Survival: For all stages combined, about 83% of persons with oral cavity and pharynx cancer survive 1 year after diagnosis. The 5-year and 10-year relative survival rates are 61% and 50%, respectively.

Ovary

New cases: An estimated 21,880 new cases of ovarian cancer are expected in the US in 2010. Ovarian cancer accounts for about 3% of all cancers among women and ranks second among gynecologic cancers, following cancer of the uterine corpus. Ovarian cancer incidence has been declining since 1985; in the most recent time period, incidence rates declined by 2.1% per year between 2001 and 2006.

Trends in 5-year Relative Survival Rates* (%) by Race and Year of Diagnosis, US, 1975-2005

	All races			White			African American		
	1975-77	1984-86	1999-2005	1975-77	1984-86	1999-2005	1975-77	1984-86	1999-2005
All sites	50	54	68†	51	55	69†	40	41	59†
Brain	24	29	36†	23	28	35†	27	32	41†
Breast (female)	75	79	90†	76	80	91†	62	65	79†
Colon	52	59	66†	52	60	67†	46	50	56†
Esophagus	5	10	19†	6	11	20†	3	8	13†
Hodgkin lymphoma	74	79	86†	74	80	87†	71	75	81†
Kidney	51	56	69†	51	56	69†	50	54	66†
Larynx	67	66	63†	67	68	66	59	53	50
Leukemia	35	42	54†	36	43	55†	34	34	46†
Liver & bile duct	4	6	14†	4	6	13†	2	5	10†
Lung & bronchus	13	13	16†	13	14	17†	12	11	13†
Melanoma of the skin	82	87	93†	82	87	93†	60‡	70§	78†
Myeloma	26	29	37†	25	27	38†	31	32	36†
Non-Hodgkin lymphoma	48	53	69†	48	54	70†	49	48	60†
Oral cavity & pharynx	53	55	63†	55	57	64†	36	36	46†
Ovary	37	40	46†	37	39	46†	43	41	37
Pancreas	3	3	6†	3	3	6†	2	5	5†
Prostate	69	76	100†	70	77	100†	61	66	98†
Rectum	49	57	69†	49	58	69†	45	46	61†
Stomach	16	18	27†	15	18	25†	16	20	26†
Testis	83	93	96†	83	93	97†	73†#	87‡	87
Thyroid	93	94	97†	93	94	98†	91	90	96
Urinary bladder	74	78	82†	75	79	83†	51	61	68†
Uterine cervix	70	68	72†	71	70	73	65	58	65
Uterine corpus	88	84	84†	89	85	87†	61	58	62

* Survival rates are adjusted for normal life expectancy and are based on cases diagnosed in the SEER 9 areas from 1975-77, 1984-86, 1999 to 2005, and followed through 2006. † The difference in rates between 1975-1977 and 1999-2005 is statistically significant ($p < 0.05$). ‡ The standard error of the survival rate is between 5 and 10 percentage points. § The standard error of the survival rate is greater than 10 percentage points. # Survival rate is for 1978-1980.

Source: Horner MJ, Ries LAG, Krapcho M, et al (eds.). *SEER Cancer Statistics Review, 1975-2006*, National Cancer Institute, Bethesda, MD, seer.cancer.gov/csr/1975_2006/, 2009.

American Cancer Society, Surveillance and Health Policy Research, 2010

Deaths: An estimated 13,850 deaths are expected in 2010. Ovarian cancer causes more deaths than any other cancer of the female reproductive system. Death rates for ovarian cancer have been decreasing by 1.4% per year since 2002.

Signs and symptoms: Early ovarian cancer usually has no obvious symptoms, although women with early stage disease occasionally experience pelvic pain. The most common sign is enlargement of the abdomen, which is caused by the accumulation of fluid. However, studies indicate that some women may experience persistent, nonspecific symptoms, such as bloating, pelvic or abdominal pain, difficulty eating or feeling full quickly, or urinary urgency or frequency. Women who experience such symptoms daily for more than a few weeks should seek prompt medical evaluation. Abnormal vaginal bleeding is rarely a symptom of ovarian cancer.

Risk factors: The most important risk factor is a strong family history of breast or ovarian cancer. Women who have had breast cancer or who have tested positive for inherited mutations in BRCA1 or BRCA2 genes are at increased risk. Studies suggest that preventive surgery to remove the ovaries and fallopian tubes in these women can decrease the risk of ovarian cancers. A genetic syndrome called hereditary nonpolyposis colon cancer (Lynch syndrome) is also associated with increased risk. The use of estrogen alone as postmenopausal hormone therapy has been shown to increase risk in several large studies. Heavier body weight appears to be associated with increased risk of ovarian cancer. Pregnancy, long-term use of oral contraceptives, and tubal ligation reduce the risk of developing ovarian cancer; hysterectomy also appears to decrease risk.

Early detection: There is currently no sufficiently accurate screening test proven to be effective in the early detection of ovarian cancer. Pelvic examination only occasionally detects ovarian cancer, generally when the disease is advanced. However, for women who are at high risk of ovarian cancer and women who have persistent, unexplained symptoms, the combination of a thorough pelvic exam, transvaginal ultrasound, and a blood test for the tumor marker CA125 may be offered. For women at average risk, transvaginal ultrasound and testing for the tumor marker CA125 may help in diagnosis but are not used for routine screening. However, a large clinical trial using these methods to assess the effect of ovarian cancer screening on mortality is currently under way in the United Kingdom.

Treatment: Treatment includes surgery and usually chemotherapy. Surgery usually involves removal of one or both ovaries, fallopian tubes (salpingo-ophorectomy), and the uterus (hysterectomy). In younger women with very early stage tumors who wish to have children, only the involved ovary and fallopian tube may be removed. In more advanced disease, surgically removing all abdominal metastases enhances the effect of chemotherapy and helps improve survival. For women with stage III ovarian cancer that has been optimally debulked (removal of as much of the cancerous tissue as possible), studies have shown that chemotherapy administered both intravenously and directly into the abdomen improves survival. Studies have found that ovarian cancer patients whose surgery is performed by a gynecologic oncologist have more successful outcomes. Clinical trials are currently under way to test two new drugs (bevacizumab and cediranib) in the treatment of ovarian cancer.

Survival: Relative survival varies by age; women younger than 65 are almost twice as likely to survive 5 years (57%) following diagnosis as women 65 and older (30%). Overall, the 1- and 5-year relative survival of ovarian cancer patients is 75% and 46%, respectively. If diagnosed at the localized stage, the 5-year survival rate is 94%; however, only 15% of all cases are detected at this stage, usually during another medical procedure. The majority of cases (62%) are diagnosed at distant stage. For women with regional and distant disease, 5-year survival rates are 73% and 28%, respectively. The 10-year relative survival rate for all stages combined is 38%.

Pancreas

New cases: An estimated 43,140 new cases of pancreatic cancer are expected to occur in the US in 2010. Incidence rates of pancreatic cancer have been stable in men since 1981, but have been increasing in women by 1.7% per year since 2000.

Deaths: An estimated 36,800 deaths are expected to occur in 2010. The death rate for pancreatic cancer has been stable in men since 2003, but has been increasing slightly (0.1% per year) since 1984 in women.

Signs and symptoms: Cancer of the pancreas often develops without early symptoms. Symptoms may include weight loss, pain in the upper abdomen that may radiate to the back, and occasionally glucose intolerance (high blood glucose levels). Tumors that develop near the common bile duct may cause a blockage that leads to jaundice (yellowing of the skin and eyes), which can sometimes allow the tumor to be diagnosed at an early stage.

Risk factors: Tobacco smoking increases the risk of pancreatic cancer; incidence rates are about twice as high for cigarette smokers as for nonsmokers. Risk also increases with a family history of pancreatic cancer and a personal history of pancreatitis, diabetes, obesity, and possibly the use of smokeless tobacco. Individuals with Lynch syndrome are at increased risk. Though evidence is still accumulating, consumption of red meat may also increase risk.

Early detection: At present, there is no method for the early detection of pancreatic cancer. The disease is usually asymptomatic; only 7% of cases are diagnosed at an early stage. Research is under way to identify better methods of early detection.

Treatment: Surgery, radiation therapy, and chemotherapy are treatment options that may extend survival and/or relieve symptoms in many patients, but seldom produce a cure. Less than 20% of patients are candidates for surgery because pancreatic cancer is usually detected after it has spread beyond the pancreas. Clinical trials have shown that for patients who do undergo surgery, adjuvant treatment with the chemotherapeutic drug gemcitabine lengthens survival. Erlotinib (Tarceva) has been approved by the FDA for the treatment of advanced pancreatic cancer. This targeted anticancer drug blocks tumor cell growth and has demonstrated a minimal improvement in pancreatic cancer survival when used along with gemcitabine. Clinical trials with several new agents, combined with radiation and surgery, may offer improved survival and should be considered as a treatment option.

Survival: For all stages combined, the 1- and 5-year relative survival rates are 25% and 6%, respectively. Even for those people diagnosed with local disease, the 5-year survival is only 22%. Obesity is associated with lower survival rates for pancreatic cancer.

Prostate

See Special Section, page 23.

Skin

New cases: More than 2 million people were treated for basal cell and squamous cell skin cancers in 2006. These types of cancer are not required to be reported to cancer registries. Most, but not all, of these forms of skin cancer are highly curable. The most common serious form of skin cancer is melanoma, which is expected to be diagnosed in about 68,130 persons in 2010. Melanoma is primarily a disease of whites; rates are more than 10 times higher in whites than in African Americans. Among whites, rates are more than 50% higher in men than in women. Melanoma incidence rates have been increasing for at least 30 years. In the most recent time period, rapid increases have occurred among young white women (3.0% per year since 1992 in those aged 15 to 39 years) and white adults 65 years and older (5.1% per year since 1985 in men and 4.1% per year since 1975 in women).

Deaths: An estimated 11,790 deaths (8,700 from melanoma and 3,090 from other nonepithelial skin cancers) will occur in 2010. The death rate for melanoma has been decreasing rapidly in whites younger than 50 by 2.9% per year since 1990 in men and by 2.2% per year since 1985 in women. In contrast, in those 50 and older death rates have been increasing by 1.0% per year since 1990 in men and have been stable since 1989 in women.

Signs and symptoms: Important warning signs of melanoma include changes in size, shape, or color of a skin lesion or the appearance of a new growth on the skin. Changes that occur over a few days are usually not cancer, but changes that progress over a month or more should be evaluated by a doctor. Basal cell carcinomas may appear as growths that are flat, or as small, raised, pink or red, translucent, shiny areas that may bleed following minor injury. Squamous cell cancer may appear as growing lumps, often with a rough surface, or as flat, reddish patches that grow slowly. Another sign of basal and squamous cell skin cancers is a sore that doesn't heal.

Risk factors: Risk factors vary for different types of skin cancer. For melanoma, major risk factors include a personal or family history of melanoma and the presence of atypical or numerous moles (more than 50). Other risk factors for all types of skin cancer include sun sensitivity (sunburning easily, difficulty tanning, natural blond or red hair color); a history of excessive sun exposure, including sunburns; use of tanning booths; diseases that suppress the immune system; and a past history of basal cell or squamous cell skin cancers.

Prevention: Skin should be protected from intense sun exposure by covering with an umbrella, clothing, and a hat, applying sunscreen that has a sun protection factor (SPF) of 15 or higher to unprotected skin, and avoiding sunbathing. Sunglasses should be worn to protect the skin around the eyes. Children in particular should be protected from the sun because severe sunburns in childhood may greatly increase risk of melanoma in later life. Tanning beds and sun lamps, which provide an additional source of UV radiation, should be avoided. In 2009, the International Agency for Research on Cancer upgraded their classification of indoor tanning devices from "probably carcinogenic to humans" to definitively "carcinogenic to humans" after a reassessment of the scientific evidence.

Early detection: The best way to detect skin cancer early is to recognize changes in skin growths or the appearance of new growths. Adults should thoroughly examine their skin on a monthly basis. New or unusual lesions or a progressive change in a lesion's appearance (size, shape, or color, etc.) should be evaluated promptly by a physician. Melanomas often start as small, mole-like growths that increase in size and may change color. A simple ABCD rule outlines the warning signals of the most common type of melanoma: **A** is for asymmetry (one half of the mole does not match the other half); **B** is for border irregularity (the edges are ragged, notched, or blurred); **C** is for color (the pigmentation is not uniform, with variable degrees of tan, brown, or black); **D** is for diameter greater than 6 millimeters (about the size of a pencil eraser). Other types of melanoma may not have these signs, so be alert for any new or changing skin growths.

Treatment: Removal and microscopic examination of all suspicious skin lesions are essential. Early stage basal and squamous cell cancers can be removed in most cases by one of several methods: surgical excision, electrodessication and curettage (tissue destruction by electric current and removal by scraping with a curette), or cryosurgery (tissue destruction by freezing). Radiation therapy and certain topical medications may be used in some cases. For malignant melanoma, the primary growth and surrounding normal tissue are removed and sometimes a sentinel lymph node is biopsied to determine stage. More extensive lymph node surgery may be needed if lymph node metastases are present. Melanomas with deep invasion or that have spread to lymph nodes may be treated with surgery, immunotherapy, chemotherapy, and/or radiation therapy. Advanced cases of melanoma are treated with palliative surgery, immunotherapy, and/or chemotherapy, and sometimes radiation therapy. Clinical trials are ongoing to evaluate drugs targeted at a particular gene mutation present in the cancer cells of about two-thirds of melanoma patients.

Survival: Most basal and squamous cell cancers can be cured, especially if the cancer is detected and treated early. Melanoma is also highly curable if detected in its earliest stages and treated properly. However, melanoma is more likely than other skin tumors to spread to other parts of the body. The 5- and 10-year relative survival rates for persons with melanoma are 91% and 90%, respectively. For localized melanoma, the 5-year survival rate is 98%; 5-year survival rates for regional and distant stage diseases are 62% and 15%, respectively. About 84% of melanomas are diagnosed at a localized stage.

Thyroid

New cases: An estimated 44,670 new cases of thyroid cancer are expected to be diagnosed in 2010 in the US, with 3 in 4 cases occurring in women. The incidence rate of thyroid cancer has been increasing sharply since the mid-1990s, and it is the fastest-increasing cancer in both men and women.

Deaths: An estimated 1,690 deaths from thyroid cancer are expected in 2010 in the US. The death rate for thyroid cancer has been increasing slightly (by 1.0% per year since 1983) in men and has been stable in women.

Signs and symptoms: The most common symptom of thyroid cancer is a lump in the neck that is noticed by a patient or felt by a health care provider in a clinical exam. Other symptoms include a tight or full feeling in the neck, difficulty breathing or swallowing, hoarseness or swollen lymph nodes, and pain in the throat or neck that does not go away. Although most lumps in the thyroid gland are not cancerous, individuals who detect an abnormality should seek timely medical attention.

Risk factors: Risk factors for thyroid cancer include being female, having a history of goiter (enlarged thyroid) or other nonmalignant thyroid condition, a family history of thyroid cancer, and radiation exposure related to medical treatment during childhood. Radiation exposure as a result of radioactive fallout

from atomic weapons testing and nuclear power plant accidents (Chernobyl) has also been linked to increased risk of thyroid cancer, especially in children. Certain rare genetic syndromes also increase risk. Individuals who test positive for an abnormal gene that causes a hereditary form of thyroid cancer can decrease the chance of developing the disease by surgical removal of the thyroid gland. Unlike other adult cancers, for which older age increases risk, more than 80% of newly diagnosed thyroid cancer patients are under age 65 years.

Early detection: At present, there is no method for the early detection of thyroid cancer. Tests used in the evaluation of thyroid nodules include: blood tests to determine levels of hormones related to normal functions of the thyroid gland; medical imaging techniques to determine the size and characteristics of the nodule and lymph nodes; and biopsy to determine if the cells in the nodule are benign or malignant.

Treatment: Most thyroid cancers are highly curable, though about 5% of cases are more aggressive and tend to spread to other organs. Treatment depends on the cell type, tumor size, and extent of the disease. The first choice of treatment is surgery. Total removal of the thyroid gland (thyroidectomy) is recommended for most patients and lymph node removal is recommended for some. Treatment with radioactive iodine (I^{131}) after surgery may be recommended to destroy any remaining thyroid tissue. Hormone therapy is given to replace hormones normally produced by the thyroid gland after thyroidectomy and to prevent the body from making thyroid-stimulating hormone, decreasing the likelihood of recurrence.

Survival: The 5-year relative survival rate for all thyroid cancer patients is 97%. However, survival varies markedly by stage, age at diagnosis, and disease subtype. The 5-year survival rate approaches 100% for localized disease, is 97% for regional stage disease, and 59% for distant stage disease. By age, the survival rate progressively decreases from 99% for patients under 45 years to 81% for those aged 75 or older.

Urinary Bladder

New cases: An estimated 70,530 new cases of bladder cancer are expected to occur in 2010. During the past two decades, bladder cancer incidence rates have been stable among men, but have been increasing slightly among women by 0.2% per year. Bladder cancer incidence is about four times higher in men than in women and two times higher in white men than in African American men.

Deaths: An estimated 14,680 deaths will occur in 2010. Mortality rates are stable in men and have been slightly declining in women (by 0.4% per year) since 1986.

Signs and symptoms: The most common symptom is blood in the urine. Other symptoms may include increased frequency or urgency of urination and irritation during urination.

Risk factors: Smoking is the most important risk factor for bladder cancer. Smokers' risk of bladder cancer is twice that of nonsmokers'. Smoking is estimated to cause about 48% of bladder cancer deaths among men and 28% among women. Workers in the dye, rubber, or leather industries and people who live in communities with high levels of arsenic in the drinking water also have increased risk. Drinking more fluids and eating more vegetables may lower the risk of bladder cancer.

Early detection: There is currently no screening method recommended for individuals at average risk. Bladder cancer is diagnosed by microscopic examination of cells from urine or bladder tissue and examination of the bladder wall with a cystoscope, a slender tube fitted with a lens and light that can be inserted through the urethra. These tests may be used to screen people at increased risk due to occupational exposure, or for follow-up after bladder cancer treatment to detect recurrent or new tumors.

Treatment: Surgery, alone or in combination with other treatments, is used in more than 90% of cases. Superficial, localized cancers may also be treated by administering immunotherapy or chemotherapy directly into the bladder. Chemotherapy, alone or with radiation before cystectomy (bladder removal), has improved treatment results. Timely follow-up care is extremely important because of the high rate of bladder cancer recurrence.

Survival: For all stages combined, the 5-year relative survival rate is 80%. Survival declines to 76% at 10 years and 72% at 15 years after diagnosis. Half of all bladder cancer patients are diagnosed while the tumor is in situ (noninvasive, present only in the layer of cells in which the cancer developed), for which cases 5-year survival is 97%. Patients with invasive tumors diagnosed at a localized stage have a 5-year survival rate of 74%; 36% of cancers are detected at this early stage. For regional and distant stage disease, 5-year survival is 36% and 6%, respectively.

Uterine Cervix

New cases: An estimated 12,200 cases of invasive cervical cancer are expected to be diagnosed in 2010. Incidence rates have decreased over most of the past several decades in both white and African American women.

Deaths: An estimated 4,210 deaths from cervical cancer are expected in 2010. Mortality rates have declined steadily over the past several decades due to prevention and early detection as a result of screening, although this trend has slowed since 2003.

Signs and symptoms: Symptoms usually do not appear until abnormal cervical cells become cancerous and invade nearby tissue. When this happens, the most common symptom is abnormal vaginal bleeding. Bleeding may start and stop between regular menstrual periods, or it may occur after sexual intercourse, douching, or a pelvic exam. Menstrual bleeding may last longer and be heavier than usual. Bleeding after menopause or increased vaginal discharge may also be symptoms.

Risk factors: The primary cause of cervical cancer is infection with certain types of human papillomavirus (HPV). Women who begin having sex at an early age or who have many sexual partners are at increased risk for HPV infection and cervical cancer. However, a woman may be infected with HPV even if she has had only one sexual partner. Importantly, HPV infections are common in healthy women and only rarely result in cervical cancer. Persistence of HPV infection and progression to cancer may be influenced by many factors, such as immunosuppression, high parity (number of childbirths), and cigarette smoking. Long-term use of oral contraceptives is also associated with increased risk of cervical cancer.

Prevention: The FDA has approved two vaccines for the prevention of the most common HPV infections that cause cervical cancer; Gardasil was approved for use in ages 9 to 26 in 2006, and Cervarix was approved for ages 10 to 25 in October 2009. The vaccines cannot protect against established infections, nor do they protect against all HPV types. For information on the American Cancer Society HPV vaccine guidelines, see Saslow D, et al. *CA: A Cancer Journal for Clinicians.* Jan 2007;57: 7-28.

Screening can prevent cervical cancer by detecting precancerous lesions. As screening has become more common, preinvasive lesions of the cervix are detected far more frequently than invasive cancer. The Pap test is the most widely used cervical cancer screening method. It is a simple procedure in which a small sample of cells is collected from the cervix and examined under a microscope. Pap tests are effective, but not perfect. Sometimes results are reported as normal when abnormal cells are present (false negative), and likewise, sometimes test results are abnormal when no abnormal cells are present (false positive). DNA tests to detect HPV strains associated with cervical cancer may be used in conjunction with the Pap test, either as an additional screening test or when Pap test results are equivocal. Fortunately, most cervical precancers develop slowly, so nearly all cases can be prevented if a woman is screened regularly. It is important for all women, even those who have received the HPV vaccine, to follow cervical cancer screening guidelines.

Early Detection: In addition to preventing cancer, cervical cancer screening can detect cancer early, when treatment is most successful. Liquid-based pap tests may be used as an alternative to conventional Pap tests. See page 62 for the American Cancer Society's screening guidelines for the early detection of cervical cancer.

Treatment: Preinvasive lesions may be treated by electrocoagulation (the destruction of tissue through intense heat by electric current), cryotherapy (the destruction of cells by extreme cold), laser ablation, or local surgery. Invasive cervical cancers are generally treated with surgery, radiation, or both, and with chemotherapy in selected cases.

Survival: One- and 5-year relative survival rates for cervical cancer patients are 87% and 71%, respectively. The 5-year survival rate for patients diagnosed with localized cervical cancer is 92%. Cervical cancer is diagnosed at an early stage more often in whites (51%) than in African Americans (43%) and in women younger than 50 (61%) than in women 50 and older (36%).

Uterine Corpus (Endometrium)

New cases: An estimated 43,470 cases of cancer of the uterine corpus (body of the uterus) are expected to be diagnosed in 2010. These usually occur in the endometrium (lining of the uterus). Incidence rates of endometrial cancer have been decreasing by about 0.5% per year since 1997 after increasing in the previous decade.

Deaths: An estimated 7,950 deaths are expected in 2010. Death rates from cancer of the uterine corpus have been stable since 1992 after decreasing an average of 1.5% per year from 1975 through 1992.

Signs and symptoms: Abnormal uterine bleeding or spotting (especially in postmenopausal women) is a frequent early sign. Pain during urination, intercourse, or in the pelvic area is also a symptom.

Risk factors: Estrogen is a strong risk factor for endometrial cancer. Factors that increase estrogen exposure include menopausal estrogen therapy (without use of progestin), being overweight/obese, late menopause, never having children, and a history of polycystic ovary syndrome. (Estrogen plus progestin menopausal hormone therapy does not appear to increase risk.) Lynch syndrome, also known as hereditary nonpolyposis colon cancer (HNPCC), increases risk. Tamoxifen use increases risk slightly. Infertility and diabetes have been associated with an increased risk. Pregnancy, the use of oral contraceptives, and physical activity provide protection against endometrial cancer.

Early detection: There is no standard or routine screening test for endometrial cancer. Most endometrial cancer (69%) is diagnosed at an early stage because of postmenopausal bleeding. Women are encouraged to report any unexpected bleeding or spotting to their physicians. The American Cancer Society recommends that women with Lynch syndrome, or otherwise at high risk for the disease, should be offered annual screening for endometrial cancer with endometrial biopsy and/or transvaginal ultrasound beginning at age 35.

Treatment: Uterine corpus cancers are usually treated with surgery, radiation, hormones, and/or chemotherapy, depending on the stage of disease.

Survival: The 1- and 5-year relative survival rates for uterine corpus cancer are 92% and 83%, respectively. The 5-year survival rate is 96%, 67%, or 17%, if the cancer is diagnosed at a local, regional, or distant stage, respectively. Relative survival in whites exceeds that for African Americans by more than 8 percentage points at every stage of diagnosis.

Special Section: Prostate Cancer

Excluding skin cancer, prostate cancer is the most commonly diagnosed cancer among men in the US and the second most common cause of cancer death among men. It is estimated that about 1 in 6 men in the US will be diagnosed with prostate cancer during their lifetime and 1 in 36 will die from this disease. Despite the important burden of prostate cancer cases and deaths, and extensive research on its causes, prevention, early detection, and treatment, many uncertainties remain about this cancer. This Special Section contains information about what we know about prostate cancer, what we don't know, and the research that has been done to try to answer these questions. Information in this article may be helpful to clinicians, men who are concerned about their risk of prostate cancer, who are making decisions about prostate cancer screening or treatment, or who are undergoing treatment or follow-up, as well as to anyone interested in learning more about this type of cancer.

How Many Cases and Deaths Are Estimated to Occur in 2010?

- Prostate cancer accounts for about 1 in 4 newly diagnosed cancers each year among US men. In 2010, an estimated 217,730 new cases of prostate cancer will be diagnosed in the US.
- Prostate cancer is the second most common cause of cancer death in men. In 2010, approximately 32,050 men are expected to die from prostate cancer. Only lung cancer accounts for more cancer deaths in US men.

Table 1. Probability (%) of Developing Prostate Cancer Over Selected Age Intervals by Race, US, 2004-2006*

Age	White	African American
30 to 39	0.01 (1 in 12,288)	0.02 (1 in 4,379)
40 to 49	0.27 (1 in 375)	0.60 (1 in 168)
50 to 59	2.14 (1 in 47)	3.78 (1 in 26)
60 to 69	6.23 (1 in 16)	9.75 (1 in 10)
70 to 79	8.02 (1 in 12)	11.17 (1 in 9)
Lifetime risk	**15.39 (1 in 6)**	**18.32 (1 in 5)**

*For people free of cancer at beginning of age interval. Percentages and "1 in" numbers may not be equivalent due to rounding.

Source: DevCan: Probability of Developing or Dying of Cancer Software, Version 6.4.1. Statistical Research and Applications Branch, National Cancer Institute, 2009. srab.cancer.gov/devcan.

Who Gets Prostate Cancer?

Age

- Age is the most important risk factor for prostate cancer. Prostate cancer incidence rates increase in men until about age 70 and decline thereafter. During 2002-2006, men aged 70 to 74 had the highest incidence rate, 888.6 cases per 100,000 white men and 1279.1 cases per 100,000 African American men.
- During 2002-2006, the median age at the time of prostate cancer diagnosis was 68 years. This means that about half of the men who developed prostate cancer were age 68 or younger at the time of diagnosis.
- The probability of developing prostate cancer varies greatly by age (Table 1). For white men who are cancer free at age 50, the probability of developing prostate cancer in the next 10 years is 2.14% (1 in 47); this rises to 8.02% (1 in 12) for a man whose current age is 70. For African American men, the probabilities are substantially greater; 3.78% (1 in 26) at age 50 and 11.17% (1 in 9) at age 70.
- Death rates for prostate cancer increase with age. During 2002-2006, the median age of death from prostate cancer was 80 years.

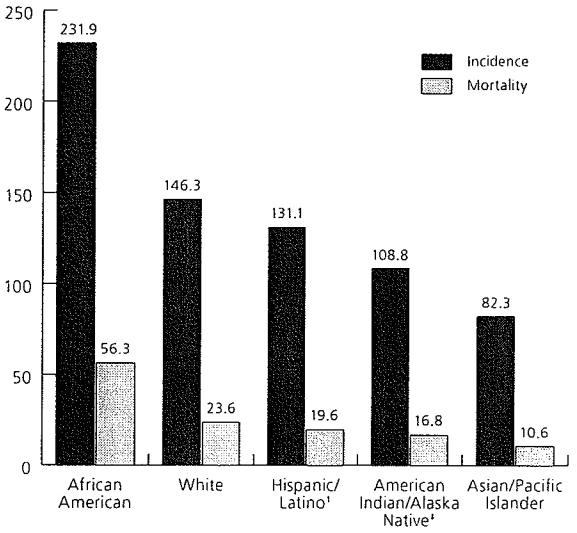
Race/Ethnicity

- African American men have a higher incidence of prostate cancer and are more likely to die from the disease than white men in every age group. In 2002-2006, the overall age-adjusted incidence rate for white men was 146.3 per 100,000, and for African American men it was 231.9 per 100,000. During the same time period, the mortality rate for white men was 23.6 per 100,000 and for African American men it was 56.3 per 100,000.[1]
- Incidence and death rates for prostate cancer are lower among men of other racial and ethnic groups than among white and African American men (Figure 1).

Socioeconomic position

- Prostate cancer death rates vary by years of education, especially among African American men. In a study of death rates among men aged 25 to 64 by level of education, American Cancer Society researchers found that the prostate cancer death rate for African American men with 12 or fewer years of education was twice that of men with more than 12 years of education.[2] In white men, the prostate cancer death rate for those with 12 or fewer years of education, was 1.5 times that of men with more than 12 years of education.
- Prostate cancer death rates declined markedly among African American and white men from 1993 to 2001. In both populations, declines were greater among men with 13 or more years of education.[3]

Figure 1. Prostate Cancer Incidence and Mortality Rates* by Race and Ethnicity, US, 2002-2006



*Per 100,000, age adjusted to the 2000 US standard population. †Persons of Hispanic/Latino origin may be of any race. ‡Data based on Contract Health Service Delivery Areas (CHSDA) counties.

Source: Edwards, et al.[1]

- A study linking data on socioeconomic factors from population surveys with cancer registries found that age-adjusted incidence rates (per 100,000) were highest among men with a college education or beyond (253.3) and lowest for men who did not complete high school (203.5). The higher incidence rates among the most educated men are likely due to higher rates of prostate-specific antigen (PSA) screening in this group. However, men with less than a high school education were significantly more likely to be diagnosed with distant-stage prostate cancer than men with a college education or beyond.[4]

Are There Geographical Differences in Prostate Cancer?

Geographical patterns within the US

- Figure 2 shows prostate cancer incidence and death rates per 100,000 men for white and African American men by state. Among white men, prostate cancer incidence rates tend to be highest in northern states, especially in the Midwest and Mountain States, while among African American men, incidence rates tend to be highest in the southeastern region. Mortality rates follow a similar pattern.
- In white men, prostate cancer incidence rates vary from 111.8 in Arizona to 184.7 in Utah. Among African American men, rates range from 113.6 in New Mexico to 277.9 in Delaware.
- Prostate cancer death rates among white men range from 19.3 in Florida to 28.4 in Idaho. Among African American men, death rates range from 35.2 in Arizona to 70.5 in Mississippi.
- A study of geographic variability in prostate cancer incidence, mortality, and PSA screening in US counties found that prostate cancer death rates were positively correlated with incidence rates of distant-stage disease for both African American and white men, suggesting a socioeconomic component to these disparities.[5]
- A study of the relationship between county-level poverty and distant-stage cancer in the US found that higher county poverty increased the odds of distant-stage prostate cancer (odds ratio = 1.7 for greater than or equal to 30% poverty compared to less than 10%).[6]

International variation

- Incidence rates vary by more than 50-fold worldwide, with the majority of cases diagnosed in economically developed countries.
- The highest incidence rates are observed in North America, Australia, and northern and central Europe.
- The lowest incidence rates are observed in southeastern and south central Asia and northern Africa.
- A 2002 study of prostate cancer incidence and mortality rates in 16 economically developed and 15 less developed countries found that incidence rates varied from < 5 per 100,000 in India, Egypt, China, and Bangladesh, to greater than 100 per 100,000 in the US and New Zealand. In the same study, the highest mortality rates were observed in Barbados (55.3 per 100,000), the Bahamas (35.6 per 100,00), Norway (28.4 per 100,000), and Sweden (27.7 per 100,000).[7] (International rates are adjusted to the 1960 world population and are not comparable to US rates presented in this publication, which are adjusted to the 2000 US population. For example, the current prostate cancer mortality rate in the US is 25.6 if age adjusted to the US standard population, but is 11.1 if age adjusted to the world standard population.)

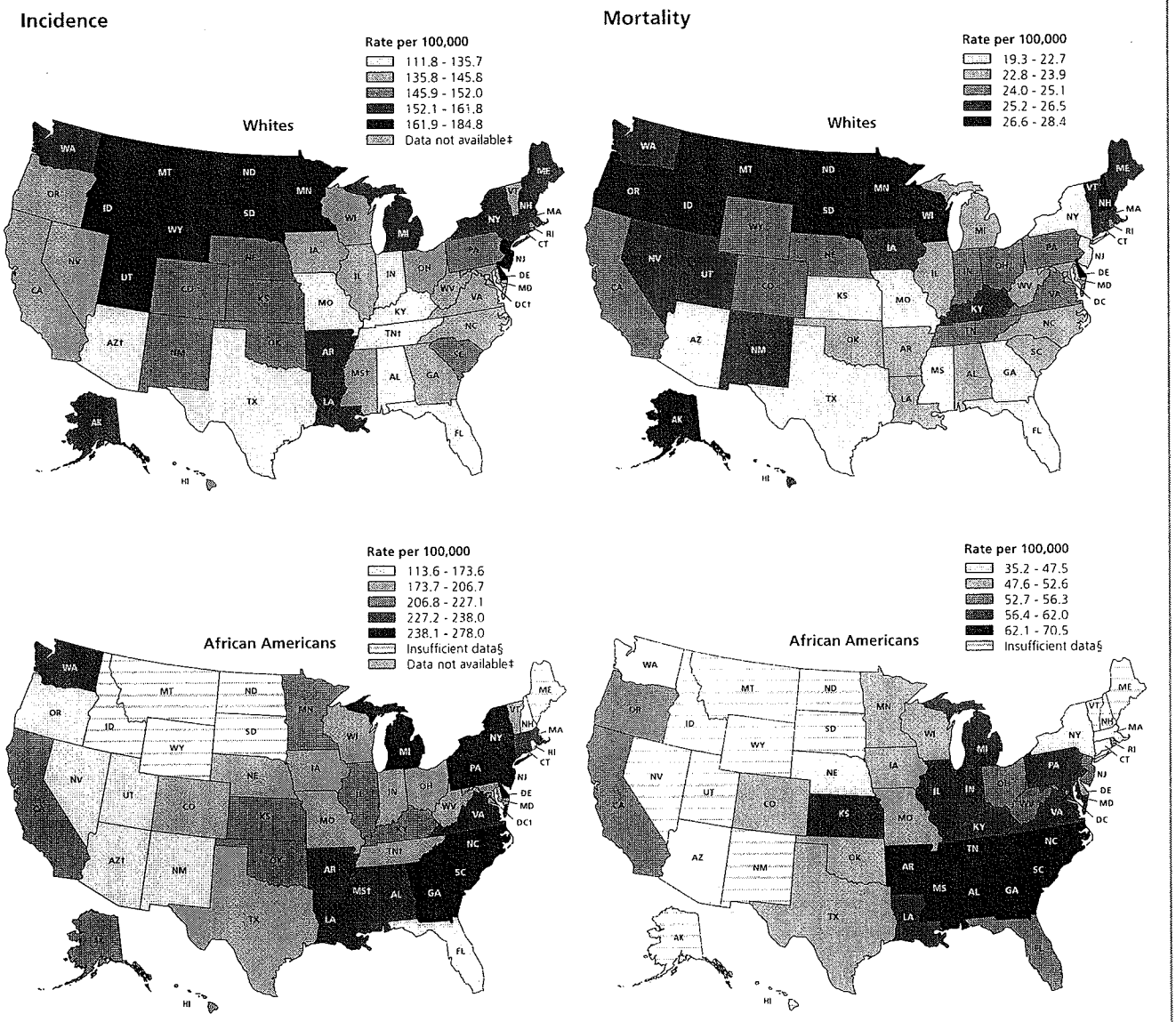
How Has the Occurrence of Prostate Cancer Changed Over Time?

Incidence trends

Incidence rates of prostate cancer for all races combined in the US show five distinct phases since 1975, when population-based surveillance of cancer began:

- Between 1975 and 1988, incidence increased by 2.6% per year.
- Between 1988 and 1992, incidence increased by 16.5% per year.
- Between 1992 and 1995, incidence decreased by 11.7% per year.
- Between 1995 and 2000, incidence was stable.
- Between 2000 and 2006, incidence rates decreased by 2.4% per year.[1]

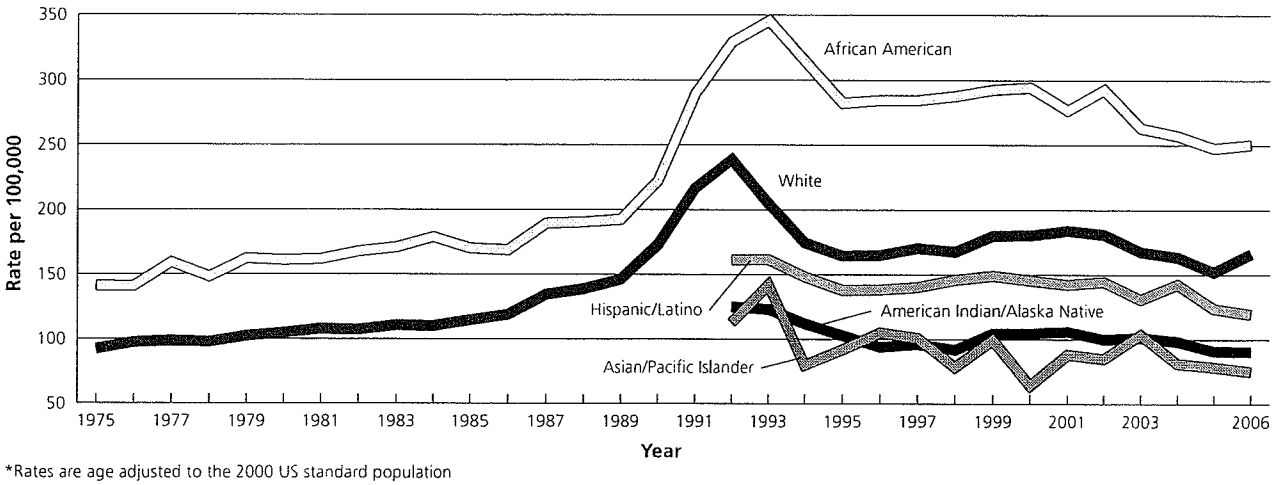
Figure 2. Prostate Cancer Incidence and Death Rates* by State and Race, US, 2002-2006



*Per 100,000 and age adjusted to the 2000 US Standard Population. †This state's registry did not achieve high-quality data standards for one or more years during 2002-2006, according to the North American Association of Central Cancer Registry (NAACCR) data quality indicators. ‡State did not submit incidence data to NAACCR for 2002-2006.
§Statistic not displayed for states with fewer than 20 cases or deaths.
Source: Incidence: NAACCR, 2009. Deaths: National Center for Health Statistics, 2009.

In large part, changes in incidence rates of prostate cancer over the past 20 years reflect changes in prostate cancer detection, most importantly, the introduction of screening with the PSA blood test. PSA is a protein secreted by the prostate and normally present at low levels in blood. Elevated levels of PSA in blood can be a sign of prostate cancer, but can also be a sign of other conditions, such as benign prostatic hyperplasia (non-cancerous enlargement of the prostate) or prostatitis (inflammation of the prostate). Use of the PSA test for the diagnosis of prostate cancer increased dramatically in the US in the late 1980s, resulting in a rapid increase in prostate cancer incidence rates that peaked in 1992.[8,9] The rapid decline in prostate cancer incidence between 1992 and 1995 likely resulted from a decline in the number of men having their first PSA test (as opposed to subsequent) tests and from a reduced number of latent cases in the population due to the rapid dissemination of the test in the early 1990s. Factors associated with the more recent decline in incidence rates among men of all ages combined are less well understood. This

Figure 3. Trends in Prostate Cancer Incidence Rates* by and Race and Ethnicity, US, 1975-2006



*Rates are age adjusted to the 2000 US standard population

Data Source: Surveillance, Epidemiology, and End Results (SEER) Program, 1973-2006, Division of Cancer Control and Population Science, National Cancer Institute, 2009. Data for whites and African Americans are from the SEER 9 registries and are adjusted for delayed reporting. Data for other races/ethnicities are from the SEER 13 registries and are not adjusted for delayed reporting, and thus data for the most recent years are likely to bo underrepresented. For Hispanics, incidence data do not include cases from the Alaska Native Registry. Incidence data for American Indians/Alaska Natives are based on Contract Health Service Delivery Area (CHSDA) counties.

decline is evident among men aged 65 and older but not among younger men.

Although African American men have much higher incidence rates than whites, incidence trends have been similar for African American and white men since the 1970s (Figure 3). Incidence rates peaked in 1992 among white men (238.2 per 100,000) and in 1993 among African Americans (344.1 per 100,000). During the most recent time period (1997-2006), incidence rates decreased by 1.9% per year among African Americans and 1.7% per year among Hispanics, while remaining relatively stable among whites, Asian Americans/Pacific Islanders, and American Indians/Alaska Natives.

Mortality trends

Mortality rates for prostate cancer also show several distinct phases:

- Between 1975 and 1987, the death rate for all races combined increased by 0.9% annually.
- Between 1987 and 1991, the rate increased by 3.0% annually.
- Between 1991 and 1994, the rate remained level.
- Between 1994 and 2006, the rate decreased by 4.1% annually.

The increase in prostate cancer death rates between 1987 and 1991, coinciding with the introduction of PSA testing and rapidly rising incidence, is likely explained by attribution bias (increased likelihood of ascribing the cause of death to prostate cancer when multiple causes are present). After leveling off from 1991 to 1994, prostate cancer death rates declined in all racial/ethnic groups. From 1997 to 2006, prostate cancer death rates declined by a minimum of 3.5% per year in each major racial/ethnic group with the exception of American Indians and Alaska Natives, in which rates were stable.[1] Similar declines in prostate cancer mortality have been observed in Australia, Canada, and several countries in western Europe.[7] Some studies suggest that much of the decline in prostate cancer death rates is due to declines in the incidence of distant-stage disease due to early detection by PSA, while others suggest that improvements in prostate cancer treatment is responsible.[10-14] Improvements in surgery and radiation and the application of hormonal treatments for regional and metastatic disease may also have contributed to the decline.[15]

Can Prostate Cancer Be Prevented?

Although many epidemiological studies have been done to investigate the etiology (causes) of prostate cancer, few modifiable risk factors have been identified. Studies have investigated the role of family history, genetic factors, nutrition, dietary supplements, obesity, physical activity, infection, medication, and hormonal factors in prostate cancer risk.

Family history

Family history of prostate cancer has been widely studied, and is positively related to prostate cancer risk. Compared to men without a family history, men with one first-degree relative (a father or brother) with the disease are two to three times more likely to develop prostate cancer, and men with more than one affected first-degree relative are three to five times more likely to be diagnosed.[16]

Race/ethnicity

International variation in prostate cancer incidence and mortality, along with striking variations in incidence and mortality within the US, may in part reflect genetic factors that vary in populations originating in different parts of the world. A particularly high risk of prostate cancer is found in many populations with sub-Saharan African ancestry, while a low risk is found in many populations with Asian ancestry. Migration studies show that men of Asian heritage living in the US have a lower risk of prostate cancer than white Americans, but a higher risk than men of Asian heritage living in Asia.[16]

Genetic factors

A large number of studies have examined potential genetic factors associated with prostate cancer risk. Men with BRCA-2 mutations are at increased risk for prostate cancer that is more aggressive and develops at a younger age.[17-19] Consistent evidence from genetic studies has also identified locations on chromosome 8 (in a region called 8q24) that are associated with an increased risk of developing prostate cancer and with more aggressive prostate cancer.[20-21]

Nutrition and dietary supplements

A variety of nutritional factors have been suggested to alter the risk of prostate cancer in large prospective cohort studies, but results are inconsistent between studies. Some studies suggest that diets with very high levels of calcium (>1,500 mg/day) or consumption of red and processed meat may be associated with increased risk.[22-23] Some studies also suggest that consumption of diets high in milk and dairy products and high intake of animal and saturated fats may increase risk.[24] Factors found in some studies to decrease risk include diets high in lycopene (a substance found in tomatoes and watermelon), selenium (a nonmetallic element found in a variety of foods), and vitamin E.[24] However, a randomized, placebo-controlled trial of selenium and vitamin E supplementation found no evidence of decreased prostate cancer risk.[25] At the present time, the best dietary advice for reducing the risk of prostate cancer is to eat at least five servings of a wide variety of fruits and vegetables each day, limit intake of red meats, avoid excessive consumption (e.g. > 3 servings/day) of dairy products, maintain an active lifestyle, and consume foods that help maintain a healthy weight.[26]

Obesity and physical activity

Associations between obesity and prostate cancer vary by stage of disease. In the American Cancer Society Cancer Prevention Study-II (CPS-II) Nutrition Cohort, higher body mass index (BMI) was associated with lower risk of non-metastatic low-grade prostate cancer, but higher risk of high-grade, metastatic, and fatal prostate cancers.[27] An analysis of physical activity found no association with overall prostate cancer risk, but a 30% lower incidence of aggressive prostate cancer among the most physically active compared to inactive men.[28] Although results of studies are not completely consistent on the relationships among prostate cancer, obesity, and physical activity, the data suggest that following the American Cancer Society guidelines to maintain a healthy body weight and be physically active may reduce the risk of developing aggressive prostate cancer and improve outcomes following treatment.[29-30]

Infection

Some studies have shown associations between sexually transmitted diseases and clinical prostatitis with prostate cancer. However, most of the evidence comes from case-control studies in which information about risk factors is obtained from patients after diagnosis, raising the possibility that recall bias influences the results.[24]

Medications

Long-term use of aspirin was associated with lower risk of prostate cancer in the CPS-II Nutrition Cohort, as well as some other studies.[31-32] However, taking aspirin or other nonsteroidal anti-inflammatory drugs (NSAIDS) for the prevention of prostate cancer is not recommended due to the potential side effects of these medications. Recent studies suggest that statins, which are prescribed to lower cholesterol levels and reduce the risk of cardiovascular disease, may reduce the risk of advanced prostate cancer.[33]

Hormonal factors

Androgens influence the maturation of the prostate and are believed to contribute to the development and progression of prostate cancer. However, studies of hormones and prostate cancer risk have been complicated by measurement issues and difficulties accounting for normal changes in hormone levels as men grow older. Thus, there is still uncertainty about how hormonal factors influence prostate cancer risk.[16]

Chemoprevention

The chemoprevention of prostate cancer is an active area of research. Two drugs of interest – finasteride and dutasteride – reduce the amount of certain male hormones in the body and are already used to treat the symptoms of an enlarged prostate. In the Prostate Cancer Prevention Trial, men who received finasteride had a 25% lower risk of developing prostate cancer than men who did not take the drug.[34] Side effects from finasteride experienced by some men in this study included erectile dysfunction, loss of libido, and breast enlargement. Recently published results from the Reduction by DUtasteride of Prostate Cancer Events (REDUCE) clinical trial found that men who received dutasteride had a 23% lower risk of developing prostate cancer than men who did not take the drug.[35] Men receiving the drug also had a lower rate of surgery for benign prostatic hypertrophy (non-malignant enlargement of the prostate) and fewer urinary problems; the risk of sexual and other side effects from dutasteride was modest.

Sunlight and vitamin D

Higher prostate cancer incidence and mortality among Caucasian populations living in more northern latitudes in the US and Europe suggest that exposure to ultraviolet radiation may be protective, possibly by increasing vitamin D synthesis. Although an ecologic study in the US found that prostate cancer mortality by county is inversely related to estimated UV radiation levels,[36] and some epidemiologic studies suggest that sun exposure may be protective, most studies examining individual blood levels of vitamin D and prostate cancer risk do not show an association.[37]

Can Prostate Cancer Be Detected Early?

Most prostate cancers are diagnosed before symptoms develop through PSA screening or a digital rectal exam (DRE). Early prostate cancer usually has no symptoms. With more advanced disease, individuals may experience weak or interrupted urine flow; inability to urinate or difficulty starting or stopping the urine flow; the need to urinate frequently, especially at night; blood in the urine; or pain or burning with urination. (It is important to note that these symptoms occur frequently as a result of non-cancerous conditions, such as prostate enlargement or infection and that none are specific for prostate cancer.) Advanced prostate cancer commonly spreads to the bones, which can cause pain in the hips, spine, ribs, or other areas.

PSA screening can usually detect prostate cancer years earlier than it would be detected by a DRE or the development of symptoms.[38] Although there is no absolute cutoff between a normal and an abnormal PSA level, screening programs in the US have commonly used >4 ng/mL to define a positive test. PSA screening has several limitations. Many men who do not have prostate cancer will screen positive and require a biopsy for diagnosis, and some men with prostate cancer do not have elevated PSA levels. In addition, because many prostate cancers grow so slowly that they may never threaten a patient's life, there is a danger of overtreatment. This is a particularly important issue since treatment for prostate cancer is often associated with significant side effects.

Two large randomized trials of prostate cancer screening with PSA testing have been completed. The US-based Prostate, Lung, Colorectal and Ovarian (PLCO) Cancer Screening Trial did not observe a mortality benefit from screening, while the European Randomized Study of Screening for Prostate Cancer (ERSPC) demonstrated a 20% reduction in prostate cancer mortality among men in the group invited for screening compared to those not invited.[39-40] Differences in the methods used in the US and European screening trials and differences in screening practices in the general population of men in the US may have contributed to differences in the results of the two trials. Because of continued uncertainty about the balance of benefits and risks, the Society stresses the importance of involving men in the screening decision.

American Cancer Society Guidelines for Early Detection of Prostate Cancer

The American Cancer Society released updated prostate cancer screening guidelines in March 2010.[41] These guidelines recommend that asymptomatic men who have at least a 10-year life expectancy have an opportunity to make an informed decision with their health care provider about whether to be screened for prostate cancer after receiving information about the uncertainties, risks, and potential benefits associated with prostate cancer screening. Screening should not occur without an informed decision-making process. Men at average risk should receive this information beginning at age 50. Men at higher risk, including African American men and men with a first-degree relative (father or brother) diagnosed with prostate cancer before age 65, should receive this information beginning at age 45. Men at appreciably higher risk (multiple family members diagnosed with prostate cancer before age 65) should receive this information beginning at age 40. Men should either receive this information directly from their health care providers or be referred to reliable and culturally appropriate sources. Patient decision aids are helpful in preparing men to make a decision about whether to be tested (Table 2). For men who are unable to decide, the screening decision can be left to the discretion of the health care provider, who should factor into the decision his knowledge of the patient's general health preferences and values.

Asymptomatic men who have less than a 10-year life expectancy based on age and health status should not be offered prostate cancer screening. At age 75, only about half of men have a life expectancy of 10 years or more. Men in this age group with significant co-morbidities (additional unrelated health issues), as well as younger men with life-limiting conditions, are not likely to benefit from screening. Life-limiting conditions become more common as men age; thus, it is important to consider overall health status – not age alone – when making decisions about screening.

Core elements of the information to be provided to men to assist with their decision include:

- Prostate cancer is an important health concern for men.
- Screening with the PSA blood test alone or with both the PSA and the DRE detects cancer at an earlier stage than if no screening is performed.
- Prostate cancer screening may be associated with a reduction in the risk of dying from prostate cancer. However, evidence is conflicting, and experts disagree about the value of screening.
- For men whose prostate cancer is detected by screening, it is currently not possible to predict which men are likely to benefit from treatment. Some men who are treated may avoid disability and death from prostate cancer. Others who are treated would have died of unrelated causes before their cancer became serious enough to affect their health or shorten their lives.

Table 2. Decision Aids for Prostate Cancer Screening

Supporting organization	Type of decision aid	Title & online access
American Cancer Society	Downloadable Document (PDF)	"Testing for Prostate Cancer" Available at: cancer.org/downloads/PRO/Testing_Prostate.pdf
Foundation for Informed Medical Decision Making	Video and Online Interactive Resource	"Is a PSA Test Right For You?" Available through Health Dialog at healthdialog.com/
Centers for Disease Control and Prevention	Downloadable Document (PDF) Culturally targeted options	"Prostate Cancer Screening: A Decision Guide" Available at: cdc.gov/cancer/prostate/pdf/prosguide.pdf "Prostate Cancer Screening: A Decision Guide for African Americans" Available at: cdc.gov/cancer/prostate/pdf/aaprosguide.pdf "La Detección del Cáncer de Próstata: Una Guia para Hispanos en los Estados Unidos" Available at: cdc.gov/cancer/prostate/pdf/prostate_cancer_spanish.pdf
MayoClinic.com	Online Resource	"Prostate Cancer Screening: Should you get a PSA test?" Available at: mayoclinic.com/health/prostate-cancer/HQ01273
University of Cardiff, UK	Online Interactive Resource	"PROSDEX: A PSA Decision Aid" Available at: prosdex.com/

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- Treatment of prostate cancer can lead to urinary, bowel, sexual, and other health problems. These problems may be significant or minimal, permanent or temporary.
- The PSA and the DRE may have false-positive or false-negative results, meaning men without cancer may have abnormal results and get unnecessary additional testing, and clinically significant cancers may be missed. False-positive results can lead to sustained anxiety about prostate cancer risk.
- Abnormal results from screening with the PSA or the DRE require prostate biopsies to determine whether the abnormal findings are cancer. Biopsies can be painful, may lead to complications like infection or bleeding, and can miss clinically significant cancer.
- Not all men whose prostate cancer is detected through screening require immediate treatment, but they may require periodic blood tests and prostate biopsies to determine the need for future treatment.

In helping men to reach a screening decision based on their personal values, once they understand the uncertainties, risks, and potential benefits, it can be helpful to provide reasons why some men decide for or against undergoing screening. For example:

- A man who chooses to be screened might place a higher value on finding cancer early, might be willing to be treated without definite expectation of benefit, and might be willing to risk injury to urinary, sexual, and/or bowel function.
- A man who chooses not to be screened might place a higher value on avoiding the potential harms of screening and treatment, such as anxiety or risk of injury to urinary, sexual, or bowel function.

The screening decision is best made in partnership with a trusted source of regular care. Men who have no access to regular care should be tested only if high-quality, informed decision-making can be assured through community-based screening programs. Such programs also must assure that participants with abnormal screening results receive appropriate counseling and follow-up care if needed. Availability of follow-up care must not be an afterthought. Unless these program elements are in place, community-based screening should not be initiated.

Once a screening decision has been made, the decision should be readdressed when new research becomes available that significantly alters the balance between benefits and risks, as well as uncertainties regarding prostate cancer early detection. In the absence of new information, the decision should be readdressed periodically, as a man's health status, values, and preferences change over time.

For men who choose to be screened for prostate cancer after considering the possible benefits and risks:

- Screening is recommended with the PSA with or without the DRE.
- Screening should be conducted yearly for men whose PSA level is 2.5 ng/ml or higher.
- For men whose PSA is less than 2.5 ng/ml, screening intervals can be extended to every 2 years.
- A PSA level of 4.0 ng/ml or higher has historically been used to recommend referral for further evaluation or biopsy, which remains a reasonable approach for men at average risk for prostate cancer.

Table 3. Examples of Prostate Cancer Treatment Recommendations by Disease Characteristics and Life Expectancy

Risk of progression & recurrence	Clinical characteristics	Life expectancy	Recommended initial treatment options
Low	T1-T2a, and Gleason score 2-6, and Blood PSA level < 10 ng/mL	< 10 years	Active surveillance
		> 10 years	Active surveillance or radical prostatectomy or radiation therapy (external beam or brachytherapy)
Intermediate	T2b-T2c, or Gleason score 7 or PSA level 10-20 ng/mL	< 10 years	Active surveillance or radical prostatectomy or radiation therapy (external beam +/- brachytherapy) +/- ADT
		> 10 years	Radical prostatectomy or radiation therapy (external beam +/- brachytherapy) +/- ADT
High risk	T3a, or Gleason 8-10 or PSA level > 20 ng/mL	All	Radical prostatectomy (selected patients) or radiation therapy (external beam) + long-term ADT

ADT = androgen deprivation therapy

Source: Prostate Cancer. *NCCN Clinical Practice Guidelines in Oncology 2009.*[34]

For PSA levels between 2.5 and 4.0 ng/ml, health care providers should consider an individualized risk assessment that incorporates other risk factors for prostate cancer, particularly for high-grade cancer, which may be used for a biopsy recommendation. Factors that increase the risk of prostate cancer include African American race, family history of prostate cancer, increasing age, and an abnormal DRE. A prior negative biopsy lowers risk.

How is prostate cancer diagnosed?

When prostate cancer is suspected, a biopsy is performed. A biopsy is a procedure in which a sample of body tissue is removed and examined under a microscope. A core needle biopsy is the main method used to diagnose prostate cancer. Several biopsy samples are taken from the prostate and evaluated to determine whether cancer is present and what grade it is based on the degree of abnormality of the cells. Additional tests may be required to determine if the cancer has spread beyond the prostate.

What Factors Influence Prostate Cancer Survival?

Prostate cancer survival rates are strongly related to stage, with a 5-year relative survival rate approaching 100% among patients diagnosed with localized or regional disease and 31% among men diagnosed at distant stage.[42] However, prostate cancer survival rates in the US are strongly influenced by widespread screening. Most prostate cancer cases are diagnosed as the result of a PSA screening test, which advances the time by which they will be diagnosed (referred to as lead time) by as much as 5 to 7 years.[38] As a result, the majority of US men with prostate cancer are diagnosed with localized disease.[42]

Among patients with localized or regional stage disease, factors associated with disease recurrence and progression include PSA level and Gleason score.[43-44] These factors, along with tumor (T) stage, extent of lymph node involvement, and life expectancy, are used to estimate the risk of progression and recurrence and to assist with treatment decisions (Table 3).[44]

- **T stage** expresses the size and extension of the tumor. T1 tumors are so small that they can't be felt during a DRE or seen with imaging such as transrectal ultrasound. T2 tumors can be felt during a DRE but appear to be confined to the prostate gland. T3 tumors have begun to grow and spread outside the prostate and may involve the seminal vesicles. T4 tumors have grown into tissues next to the prostate (other than the seminal vesicles), such as the bladder sphincter (muscle that helps control urination), the rectum, and/or the wall of the pelvis. Patients with T3 tumors have AJCC Stage III (regional stage disease) and those with T4 tumors are considered to have AJCC Stage IV (distant stage disease).
- **PSA level** and velocity (rate of increrase over time) have been associated with the likelihood of recurrence or progression. PSA levels of less than 10 ng/mL are considered to be low risk; 10-20 ng/mL, intermediate risk; and greater than 20 ng/mL, high risk. A PSA velocity of greater than 2 ng/mL in the year prior to diagnosis is associated with both a greater risk of disease relapse and a higher risk of prostate cancer death following treatment.[45-46]
- **Gleason score** expresses the grade of the tumor, which is the degree to which it resembles normal prostate tissue. Higher Gleason scores indicate larger differences from normal tissue and more aggressive disease. Cancers with Gleason scores of 2 to 4 are sometimes called well differentiated or low grade; cancers with Gleason scores of 5 to 7 may be called moderately differentiated or intermediate grade; and cancers with Gleason scores of 8 to 10 may be called poorly differentiated or high grade.

Survival rates for prostate cancer differ by race and ethnicity. After controlling for age and stage at diagnosis, the risk of cancer death after diagnosis when compared to non-Hispanic whites is highest for American Indian and Alaska Native men (1.81), followed by African American (1.31) and Hispanic white men (1.12). Asian and Pacific Islander men are less likely than white men to die from prostate cancer (0.70).[47] Survival differences by race/ethnicity may be attributed to differences in prognostic factors and/or differences in access to care and treatment patterns. A study in the American Cancer Society Cancer Prevention Study-II (CPS-II) Nutrition Cohort found that men with at least a high school education were 50% less likely to die after prostate cancer diagnosis than those with less than a high school education, even after accounting for differences in age, race, stage, and grade.[48]

How Is Prostate Cancer Treated?

Most men with prostate cancer have several treatment options available to them and participate in treatment decisions along with their health care providers. Treatment recommendations vary by disease severity and life expectancy since the side effects of treatment may outweigh the potential benefits for men whose cancers are unlikely to progress in their lifetime (Table 3). The major treatments for clinically localized prostate cancer are active surveillance, radical prostatectomy, and radiation therapy, with active surveillance more likely to be recommended for men of any age with low risk cancer and for those with less than 10 years of life expectancy. Patients with locally advanced prostate cancer are generally recommended to receive external beam radiation along with androgen deprivation therapy (ADT); some may be eligible for radical prostatectomy as an alternative to external beam radiation. Patients with lymph node metastasis may receive ADT alone or a combination of external beam radiation and ADT, while those with metastatic disease will generally receive ADT alone.

Figure 4 shows the primary treatment selected among men diagnosed with localized prostate cancer in 2004-2006 in 17 areas covered by Surveillance, Epidemiology, and End Results (SEER) registries, by risk category and age at diagnosis. The category "no treatment" in this figure includes active surveillance, for which there is no specific treatment code, as well as ADT, which is not accurately coded in registry data and therefore not available for analysis in publically available SEER data. As would be expected when treatment recommendations are based on life expectancy, younger men (under 65) have the highest probability of receiving potentially curative treatment (radical prostatectomy or radiation therapy) across all risk categories, whereas older men (75+) are least likely to receive curative treatment.

Each type of treatment is associated with potential risks and benefits, which men should understand in order to choose treatment based on the factors most important to them.[49] The main benefit of active surveillance is that it may allow definitive treatment to be postponed indefinitely or for many years, during which time the man will not be affected by complications or side effects of treatment. On the other hand, there is a risk that if the cancer does progress, delayed treatment may make it more difficult to cure. Radical prostatectomy and radiation therapy with or without hormonal therapy are recommended for men for whom there is a reasonable chance of cure and who have a life expectancy greater than 10 years. Surgical and radiation treatment may result in urinary incontinence, problems in bowel function, and reduced ability to achieve and maintain an erection. Some of these problems may decline as time passes, but others may increase. Hormonal treatment may be offered as an adjunct (addition) to other forms of treatment, or may be used as primary treatment for advanced disease and for men with short life expectancy. Side effects of hormonal treatment may include loss of libido (interest in sex), hot flashes, osteoporosis (low bone density), and an increased risk of diabetes and cancer. The American Cancer Society recently collaborated with the American Heart Association and the American Urological Association to issue an advisory about the cardiovascular risks associated with ADT.[50]

Prostate Cancer Treament Options

Active surveillance involves monitoring the course of disease with the expectation to intervene if the cancer progresses. Active surveillance is often offered to men who have low-risk disease and/or limited life expectancy. Monitoring under active surveillance involves PSA testing every 3 to 6 months, DRE every 6 to 12 months, and may involve additional biopsies.

Radical prostatectomy involves surgical removal of the prostate along with nearby tissues. Regional lymph nodes may also be removed for examination to determine whether lymph node metastases are present. Several approaches can be used for radical prostatectomy, including conventional (open) surgery and several minimally invasive (laparoscopic) surgical techniques. Nerve-sparing surgery is done where possible to increase the likelihood that normal sexual function is preserved.

The two types of **radiation therapy** used for prostate cancer are **external beam radiation** and **brachytherapy**.

In **external beam radiation**, the patient receives radiation treatment from an external source, usually over an 8- to 9-week period. Patients with intermediate- or high-risk cancers may be recommended for pelvic lymph node irradiation and/or ADT in addition to external beam radiation to the prostate.

Brachytherapy involves placing small radioactive pellets, sometimes referred to as seeds, into the prostate tissue. Most centers use permanent, low-dose implants that gradually lose their radioactivity over time. Brachytherapy treatment alone may be recommended for low-risk cancers, and combined with external beam radiation therapy (with or without ADT) for intermediate-risk cancers.

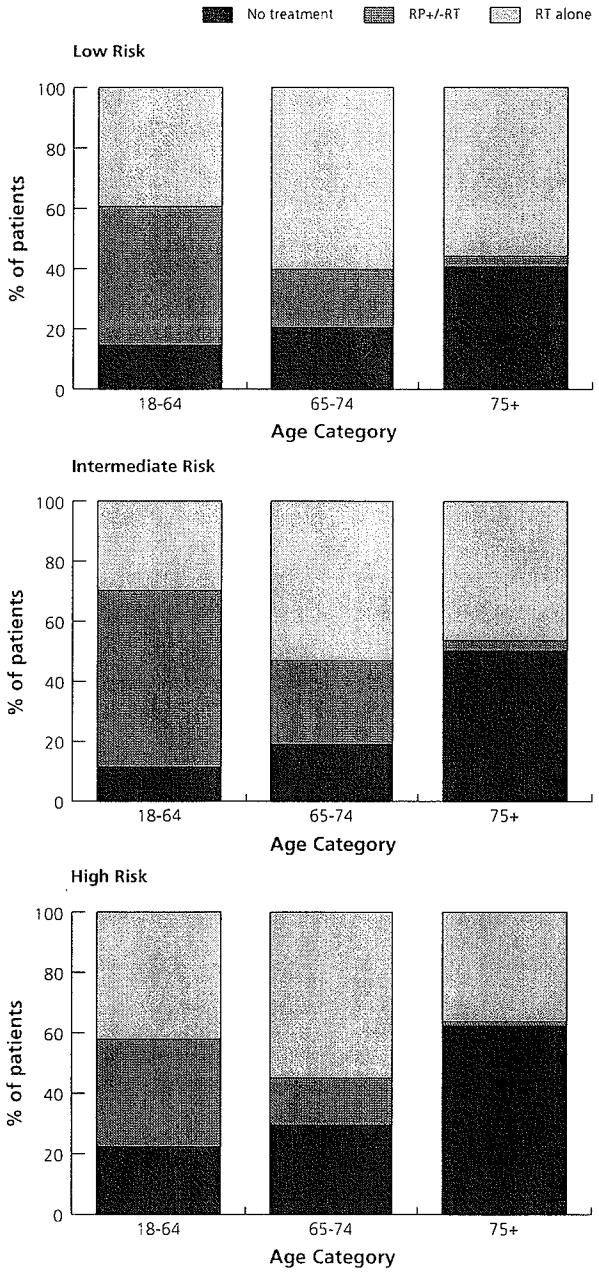
Androgen deprivation therapy (ADT), or hormone therapy, alters the effects of male hormones on the prostate through medical or surgical castration (elimination of testicular function) and/or administration of antiandrogen medications.

Men who receive curative-intent treatment with either radical prostatectomy or radiation therapy are usually monitored for cancer recurrence by measuring PSA levels every 6 to 12 months for the first 5 years and annually thereafter. Men who have radical prostatectomy are considered to have biochemical recurrence if their PSA level never falls to undetectable after surgery, or if they achieve an undetectable PSA after surgery, but have a subsequent detectable PSA that increases on two or more laboratory tests. Many men who do have a biochemical recurrence do not develop detectable metastases for many years. For example, one study found that the median time from PSA elevation to metastases was 8 years.[51] Several types of treatment options are available for patients whose prostate cancer has recurred or progressed.[52]

Disparities in stage at diagnosis and treatment

- Analyses of data from the National Cancer Database, a national hospital-based registry, found that patients without health insurance or with Medicaid insurance were more likely than those with private insurance to be diagnosed with advanced stage (AJCC Stage III-IV) prostate cancer, compared to early stage (AJCC Stage I-II) prostate cancer.[53-54] Insurance status is associated with access to preventive services and primary care. The 2006 National Health Interview Survey (NHIS) found that 53.6% of uninsured adults had no usual source of health care, compared with 9.9% of privately insured adults.
- A study of factors associated with PSA screening within the past 2 years using 2005 NHIS data found that men without a usual source of health care were significantly less likely to have had a PSA test within the past 2 years. Among men aged 50-79, 51.2% of those with a usual source of care had a recent PSA test, compared to 25.3% without.
- Previous studies have documented that African Americans were more likely than whites to be diagnosed with advanced stage prostate cancer. From 1988-1989 to 2004-2005, however, the incidence (per 100,000) of T3 and T4 prostate cancers among African American patients decreased from 90.9 to 13.3 while the incidence among whites decreased from 52.7 to 7.9.[55] Figure 5 shows trends in incidence rates by stage for African American and white men from 1988 to 2006. These figures suggest that as overall incidence rates for more advanced disease (including localized T3 and T4 tumors as well as regional and distant stage) have declined, disparities in disease severity by race have also been reduced. Table 4 compares disease severity characteristics among African American and white men diagnosed in 2004-2006. Although African American men continue to have higher PSA levels at diagnosis, the distribution of Gleason scores is now quite similar.

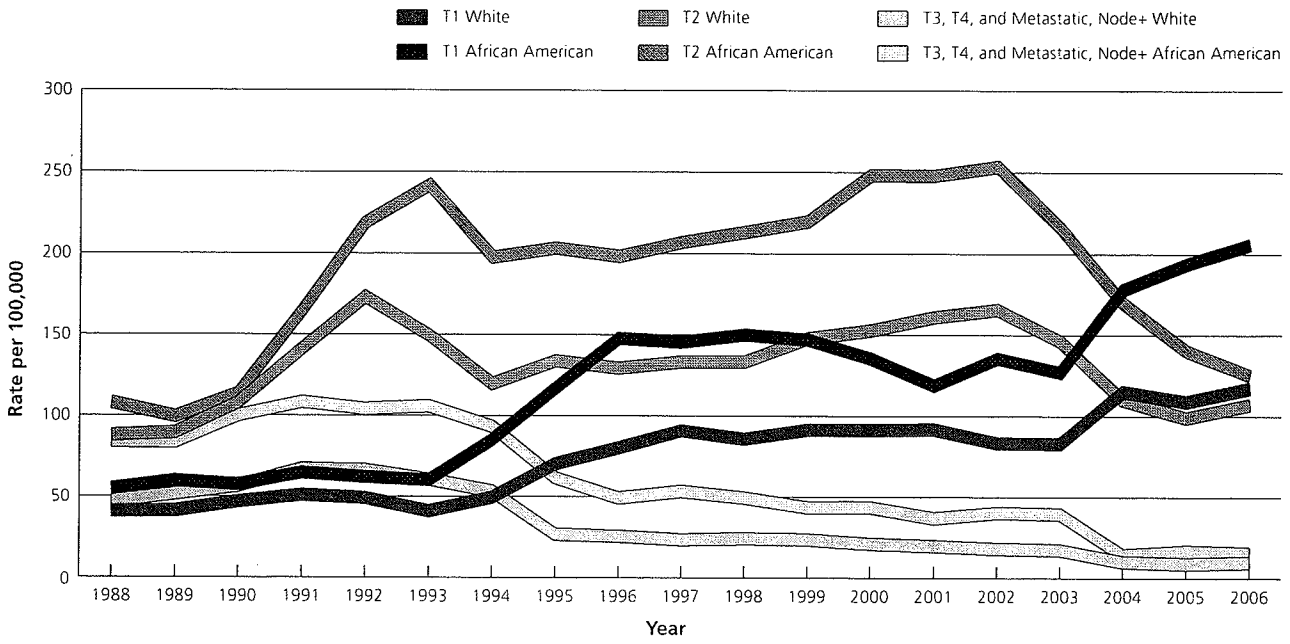
Figure 4. Prostate Cancer Treatment Patterns by Risk Category (Disease Severity) and Age, US, 2004-2006



RP = radical prostatectomy, RT = radiation therapy

Data Source: Surveillance Epidemiology and End Results (SEER) Program, SEER 17 Registries, 2004-2006, Division of Cancer Control and Population Science, National Cancer Institute, 2009.

Figure 5. Trends in Prostate Cancer Incidence by Stage and Race, US, 1988-2006



Data Source: Surveillance, Epidemiology, and End Results (SEER) Program, SEER 9 Registries, 1988-2006, Division of Cancer Control and Population Science, National Cancer Institute, 2009.

- Decreasing disparities in disease severity between African Americans and whites likely result from increased awareness of the higher prostate cancer risk among African Americans among health care providers and the general public and the uptake of PSA screening among African American men. The 2005 NHIS found that non-Hispanic African American men aged 40-49 were more likely to have had a PSA test in the past 2 years than non-Hispanic white men (25.7% and 14.6%, respectively). Men aged 40-49 with a family history of prostate cancer were more likely to have had a PSA test than men with no family history (36.6% and 14.8%, respectively). These data suggest that health care practitioners are implementing recommendations for discussing PSA screening at an earlier age with high-risk men, including African Americans and those with a family history of prostate cancer. The prevalence of recent PSA screening among 50- to 79-year-old men was 49.9% in non-Hispanic African Americans and 48.8% in non-Hispanic whites. An analysis of data from the NHIS 2000 survey found that the majority (73.8%) of African American men who had had at least one PSA test reported that they had physician discussions about the advantages and disadvantages of the test.[56]

Numerous studies have documented differences in treatment between African American and white men with prostate cancer.[57-60] In particular, African American men with localized prostate cancer are less likely to have curative treatment (radical prostatectomy or radiation therapy). Among patients receiving curative treatment, African American men are more likely to receive radiation therapy than radical prostatectomy.[57, 61] Differences in treatment patterns by race persist in the most recent years of data available from the SEER registries (Table 5). Differential treatment patterns by race/ethnicity may result from health system, physician, and patient factors, including communication and understanding of treatment options.[57, 62-65] Several studies have also found higher levels of medical mistrust among African American men with prostate cancer, particularly those who delayed seeking care.[66-67] Disparities in receipt of curative treatment among African American and Hispanic patients may contribute to poorer survival in these groups.[47, 55, 68] Previous studies have reported African American and white patients with various types of cancer have similar survival rates when recommended treatment is administered uniformly and where patients are treated in equal-access facilities.[69-70]

Table 4. Prostate Cancer Age Distribution and Clinical Characteristics (%) by Race, US, 2004-2006

Characteristic	All patients	White	Black
Age			
Mean	67.0	68.0	65.0
18-64	40.0	38.5	49.9
65-74	35.3	35.5	33.6
75+	24.8	26.0	16.5
PSA level, ng/mL			
Median	6.5	6.4	7.2
≤2.5	7.0	7.2	5.7
2.6-4	6.7	6.9	5.6
4.1-6.9	32.5	32.9	30.0
7-10	15.7	15.7	15.5
10.1-20	12.9	12.6	14.9
>20	10.9	10.3	15.0
Unknown	14.3	14.4	13.3
Gleason Score			
2-6	46.3	46.8	42.8
3+4	23.7	23.5	25.1
4+3	9.3	9.2	9.8
8-10	14.2	14.1	14.9
Unknown	6.5	6.4	7.4
Clinical Tumor Stage			
T1	52.2	51.8	55.3
T2	39.5	40.0	36.2
T3	2.3	2.4	2.2
T4	1.0	1.0	1.3
Unknown	5.0	5.0	5.0
Seer Summary Stage			
Localized	80.9	80.9	80.9
Regional	11.7	11.9	10.4
Distant	4.3	4.1	5.7
Unknown	3.1	3.1	3.0

Data Source: Surveillance, Epidemiology, and End Results (SEER) Program, SEER 17 Registries, 2004-2006, Division of Cancer Control and Population Science, National Cancer Institute, 2009.

Survivorship

The National Cancer Institute estimates that approximately 2.2 million men with a history of prostate cancer were alive in January 2006. Nearly half of all male cancer survivors in the US are prostate cancer survivors. The prominence of prostate cancer survivors results in part from the large number of men diagnosed every year (217,730 in 2010) and the very high relative survival rates for this cancer. Prostate cancer survivors face a number of challenges, including the possibility of recurrence, complications of treatment, and functional impairments, which can severely impact quality of life. Many studies are under way to improve treatment for prostate cancer and improve quality of life for survivors. Important areas of research include how to better differentiate between early cancers that need aggressive treatment and those that can be safely left untreated and how to improve existing treatments so that they are less likely to produce unwanted side effects.

The decisions regarding the treatment and management of prostate cancer are often difficult because of the significant side effects of treatment that include sexual dysfunction, incontinence, urinary irritation, and bowel problems, all of which may have a negative impact on quality of life. One of the most common and most distressing side effects of prostate cancer treatment is the impact on sexual function, with upward of 75% of prostate cancer survivors reporting some degree of post-treatment erectile dysfunction.[71-73] Sexual dysfunction and urinary problems are common among prostate cancer survivors receiving radical prostatectomy, external beam radiation, or brachytherapy.[74-75] Recent findings suggest that nerve-sparing surgical procedures may mitigate some of the sexual side effects associated with radical prostatectomy.[76] In addition to functional impairments in sexuality, men whose treatment includes androgen suppression (the suppression or blockage of male hormones through surgery or hormone therapy) may experience a feminization of the body, reduced sexual desire, and diminished intimacy with their spouse.[77]

The physical side effects of prostate cancer treatment can lead to significant emotional and psychological distress, as well as complications in spousal or partnered relationships.[78] In addition, other emotional concerns such as fears about disease progression and recurrence, anxiety, and depression may also have a negative impact on prostate cancer survivors' quality of life. Findings from the Cancer of the Prostate Strategic Urologic Research Endeavor (CaPSURE) study, a national disease registry with more than 10,000 prostate cancer patients, indicated that 2 years after completion of treatment, fears about disease recurrence remained high, particularly among those with poorer physical health.[79] Likewise, a study of prostate cancer patients using Medicare data found that elevated PSA scores and secondary androgen ablation therapy were associated with rising fears of recurrence and poorer quality of life.[80] Still other research has begun to investigate prostate cancer survivors' perceptions about the effectiveness of their treatments and satisfaction with their treatment decisions. One study reported that most men felt confident that their cancer was well controlled and were satisfied with their treatment decisions.[81] However, a different set of factors affected each of these issues; perceived cancer control was most affected by adverse medical factors such as high Gleason scores whereas confidence in treatment decisions was highest among men who received radical prostatectomy or brachytherapy. In a large, multi-center study of more than 1,200 prostate cancer patients, satisfaction with treatment outcomes was significantly associated with patients' changes in sexual and urinary function, as well as with the degree of emotional distress among their spouses.[76]

Table 5. Prostate Cancer Treatment (%) by Race and Disease Severity, US, 2004-2006

	White			Black		
Risk of progression & recurrence	No treatment	RP+/-RT	RT alone	No treatment	RP+/-RT	RT alone
Low	17.7	35.7	46.8	20.9	26.7	52.5
Intermediate	18.3	45.2	36.4	21.3	40.3	38.5
High	32.2	28.2	39.6	38.0	22.9	39.1
Total	21.2	38.6	40.4	25.4	32.3	42.3

RP = radical prostatectomy; RT = radiation therapy

Data Source: Surveillance, Epidemiology, and End Results (SEER) Program, SEER 17 Registries, 2004-2006, Division of Cancer Control and Population Science, National Cancer Institute, 2009.

An important issue when considering the side effects of prostate cancer treatment is the degree to which these symptoms occur as part of the normal aging process. Hoffman et al. compared participants in the Prostate Cancer Outcomes Study (PCOS) to age- and ethnicity-matched controls with no history of prostate cancer and found that over a 5-year period, prostate cancer survivors had significantly greater declines in both sexual and urinary function.[82] Patients also reported higher levels of distress associated with these declines, but bowel function and general quality of life scores were not affected by cancer status.[82] In summary, treatment for prostate cancer is associated with complications that may negatively impact patient quality of life. In light of the currently documented modest gains in life expectancy from aggressive treatment when compared to clinical observation (active surveillance or watchful waiting), it is important for patients and their providers to discuss potential side effects as they relate to quality of life during treatment decision-making.

American Cancer Society Research

The American Cancer Society Cancer Prevention Study-II (CPS-II) is part of a large, international consortium that includes more than 16,000 cases of prostate cancer. The mission of this consortium is to identify genetic factors that increase risk for cancer, and further to study how these genetic factors interact with lifestyle and environmental factors. Through the work of this consortium, the first genetic markers ever to be associated with risk of prostate cancer were identified. These markers are currently being used in risk prediction models to help identify men at high risk of prostate cancer.

The American Cancer Society funds individual investigators in medical schools, universities, research institutes, and hospitals throughout the country through its Extramural Grants program. The program is currently funding 97 grants in prostate cancer research, totaling $54,973,800. Ongoing studies include:

- The identification of biologic markers for the early detection of recurrent prostate cancer
- Stress management and exercise during prostate cancer treatment
- The role of inflammation in prostate cancer
- Improving magnetic resonance imaging of prostate cancer
- Racial and ethnic differences in prostate cancer risk and treatment
- Understanding the molecular mechanisms of prostate cancer

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Cancer Disparities

An overarching objective of the American Cancer Society's 2015 challenge goals is to eliminate disparities in the cancer burden among different segments of the US population defined in terms of socioeconomic status (income, education, insurance status, etc.), race/ethnicity, residence, sex, and sexual orientation. The causes of health disparities within each of these groups are complex and interrelated, but likely arise from inequities in work, wealth, income, education, housing, and overall standard of living, as well as social barriers to high-quality cancer prevention, early detection, and treatment services.

Socioeconomic Status

Persons with lower socioeconomic status (SES) have disproportionately higher cancer death rates than those with higher SES, regardless of demographic factors such as race/ethnicity. For example, all cancer mortality rates among both African American and non-Hispanic white men with 12 or fewer years of education are more than twice those in men with higher levels of education. Further, progress in reducing cancer death rates has been slower in persons with lower socioeconomic status. These disparities occur largely because persons with lower SES are at higher risk for cancer and have less favorable outcomes after diagnosis. Persons with lower socioeconomic status are more likely to engage in behaviors that increase cancer risk, such as tobacco use, physical inactivity, and poor diet, in part because of marketing strategies that target these populations and in part because of environmental or community factors that provide fewer opportunities for physical activity and less access to fresh fruits and vegetables. Lower socioeconomic status is also associated with financial, structural, and personal barriers to health care, including lack of or inadequate health insurance, reduced access to recommended preventive care and treatment services, and lower literacy rates. Individuals with no health insurance are more likely to be diagnosed with advanced cancer. For more information about the relationship between health insurance and cancer, see *Cancer Facts & Figures 2008*, Special Section, available online at cancer.org.

Racial and Ethnic Minorities

Disparities in the cancer burden among racial and ethnic minorities largely reflect obstacles to receiving health care services related to cancer prevention, early detection, and high-quality treatment, with poverty (low SES) as the overriding factor. According to the US Census Bureau, in 2008, 1 in 4 African Americans and Hispanics/Latinos lived below the poverty line, compared to 1 in 10 non-Hispanic whites. Moreover, 1 in 5 African Americans and 1 in 3 Hispanics/Latinos were uninsured, while only 1 in 10 non-Hispanic whites lacked health insurance.

Discrimination is another factor that contributes to racial/ethnic disparities in cancer mortality. Racial and ethnic minorities tend to receive lower quality health care than whites even when insurance status, income, age, and severity of conditions are comparable. Overall, social inequalities, including discrimination, communication barriers, and provider assumptions, can affect interactions between patient and physician and contribute to miscommunication or delivery of substandard care.

In addition to poverty and social discrimination, cancer risks and rates in a population may also be influenced by cultural and/or inherited factors that decrease or increase risk. For example, in cultures where early marriage is encouraged, women may have a lower risk of breast cancer because they begin having children at a younger age, which decreases breast cancer risk. Higher rates of cancers related to infectious agents (stomach, liver, uterine cervix) in populations that include a large number of recent immigrants may reflect a higher prevalence of infection in the country of origin. Individuals who maintain a primarily plant-based diet or do not use tobacco because of cultural or religious beliefs have a lower risk of many cancers. Genetic factors may also explain some differences in cancer incidence. For example, women from population groups with an increased frequency of mutations in the BRCA1 and BRCA2 genes, such as women of Ashkenazi Jewish descent, have an increased risk of breast and ovarian cancer. Genetic factors may also play a role in the elevated risk of prostate cancer among African American men and the incidence of more aggressive forms of breast cancer in African American women. However, genetic differences associated with race are thought to make a minor contribution to the disparate cancer burden between different racial/ethnic populations. Below is a brief overview of the cancer burden for each of the four major nonwhite racial/ethnic groups.

African Americans: African Americans are more likely to develop and die from cancer than any other racial or ethnic group. The death rate for cancer among African American males is 34% higher than among white males; for African American females, it is 17% higher than among white females. African American men have higher incidence and mortality rates than whites for each of the cancer sites listed on page 39 with the exception of kidney cancer, for which rates are about the same. For more information on cancer in African Americans, see *Cancer Facts & Figures for African Americans 2009-2010*, available online at cancer.org/statistics.

Hispanics: Hispanics have lower incidence rates for all cancers combined and for most common types of cancer compared to whites, but they have higher rates of cancers associated with infection, such as uterine cervix, liver, and stomach. For example, incidence rates of liver cancer are about twice as high in Hispanic men and women as in whites. For more information on cancer in Hispanics, see *Cancer Facts & Figures for Hispanics/Latinos 2009-2011*, available online at cancer.org/statistics.

Cancer Incidence and Death Rates* by Site, Race, and Ethnicity, US, 2002-2006

Incidence	White	African American	Asian American and Pacific Islander	American Indian and Alaska Native†	Hispanic/ Latino‡
All sites					
Male	550.1	626.0	334.5	318.4	430.3
Female	420.0	389.5	276.3	265.1	326.8
Breast (female)	123.5	113.0	81.6	67.2	90.2
Colon & rectum					
Male	58.2	68.4	44.1	38.1	50.0
Female	42.6	51.7	33.1	30.7	35.1
Kidney & renal pelvis					
Male	19.7	20.6	9.0	16.6	18.2
Female	10.3	10.6	4.5	10.6	10.3
Liver & bile duct					
Male	8.0	12.5	21.4	8.9	15.9
Female	2.8	3.8	8.1	4.6	6.2
Lung & bronchus					
Male	85.9	104.8	50.6	57.9	49.2
Female	57.1	50.7	27.6	41.3	26.5
Prostate	146.3	231.9	82.3	82.7	131.1
Stomach					
Male	8.9	16.7	17.5	9.4	14.3
Female	4.2	8.5	9.8	4.7	8.6
Uterine cervix	7.9	11.1	7.6	6.6	12.7

Mortality	White	African American	Asian American and Pacific Islander	American Indian and Alaska Native†	Hispanic/ Latino‡
All sites					
Male	226.7	304.2	135.4	183.3	154.8
Female	157.3	183.7	95.1	140.1	103.9
Breast (female)	23.9	33.0	12.5	17.6	15.5
Colon & rectum					
Male	21.4	31.4	13.8	20.0	16.1
Female	14.9	21.6	10.0	13.7	10.7
Kidney & renal pelvis					
Male	6.1	6.0	2.4	9.0	5.2
Female	2.8	2.7	1.2	4.2	2.4
Liver & bile duct					
Male	6.8	10.8	15.0	10.3	11.3
Female	2.9	3.9	6.6	6.5	5.1
Lung & bronchus					
Male	69.9	90.1	36.9	48.0	33.9
Female	41.9	40.0	18.2	33.5	14.4
Prostate	23.6	56.3	10.6	20.0	19.6
Stomach					
Male	4.8	11.0	9.6	9.8	8.3
Female	2.4	5.3	5.8	4.6	4.8
Uterine cervix	2.2	4.6	2.2	3.4	3.1

* Per 100,000, age adjusted to the 2000 US standard population.

† Data based on Contract Health Service Delivery Areas, comprising about 55% of the US American Indian/Alaska Native population; for more information, please see: Espey DK, Wu XC, Swan J, et al. Annual report to the nation on the status of cancer, 1975-2004, featuring cancer in American Indians and Alaska Natives. ‡ Persons of Hispanic/Latino origin may be of any race.

Source: Edwards BK, Ward E, Kohler BA, et al. Annual report to the nation on the status of cancer, 1975-2006. Cancer. 2010;116:544-573.

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Asian Americans and Pacific Islanders: Similar to Hispanics, Asian Americans and Pacific Islanders have lower incidence rates than whites for the most common cancer sites, but higher rates for many of the cancers related to infection. As shown in the table on page 39, they have the highest incidence rates for liver and stomach cancers of all racial and ethnic groups in both men and women, and among the highest death rates for these cancer sites. Liver cancer incidence among Asian American and Pacific Islander men and women is more than 30% higher than that among Hispanics, who have the second-highest rates. (For more information on cancers related to infection, see *Cancer Facts & Figures 2005*, Special Section, available online at cancer.org.)

American Indians and Alaska Natives: Mortality rates for kidney cancer in American Indian and Alaska Native men and women are higher than in any other racial or ethnic population. Cancer information for American Indians and Alaska Natives is known to be incomplete because the racial/ethnic status of many of these individuals is not correctly identified in medical and death records. Although efforts have been made to collect more accurate information through linkage with the Indian Health Service records, available statistics probably do not represent the true cancer burden in this population.

Note: It is important to recognize that although cancer data in the US are primarily reported for broad racial and ethnic minority groups, these populations are not homogenous. There are significant variations in the cancer burden within each racial/ethnic group. For example, among Asian Americans, incidence rates for cervical cancer are almost three times as high in Vietnamese women as in Chinese and Japanese women, partly because the Vietnamese, in general, immigrated more recently, are poorer, and have less access to cervical cancer screening.

Geographic Variability

Cancer rates in the US vary widely by geographic area. The figure on page 41 depicts geographic variability in lung cancer mortality by state and sex in the US. Among both men and women, lung cancer death rates are 3-fold higher in Kentucky (108 and 56 per 100,000 in men and women, respectively), the state with the highest rates, than in Utah (33 and 18 per 100,000 in men and women, respectively), which has the lowest rates. These differences reflect the large and continuing differences in smoking prevalence among states, which is influenced to some extent by state tobacco control legislative policies. Geographic variations also reflect differences in environmental exposures and socioeconomic factors in population demographics. For more information about cancer disparities, see *Cancer Facts & Figures 2004*, Special Section, available online at cancer.org.

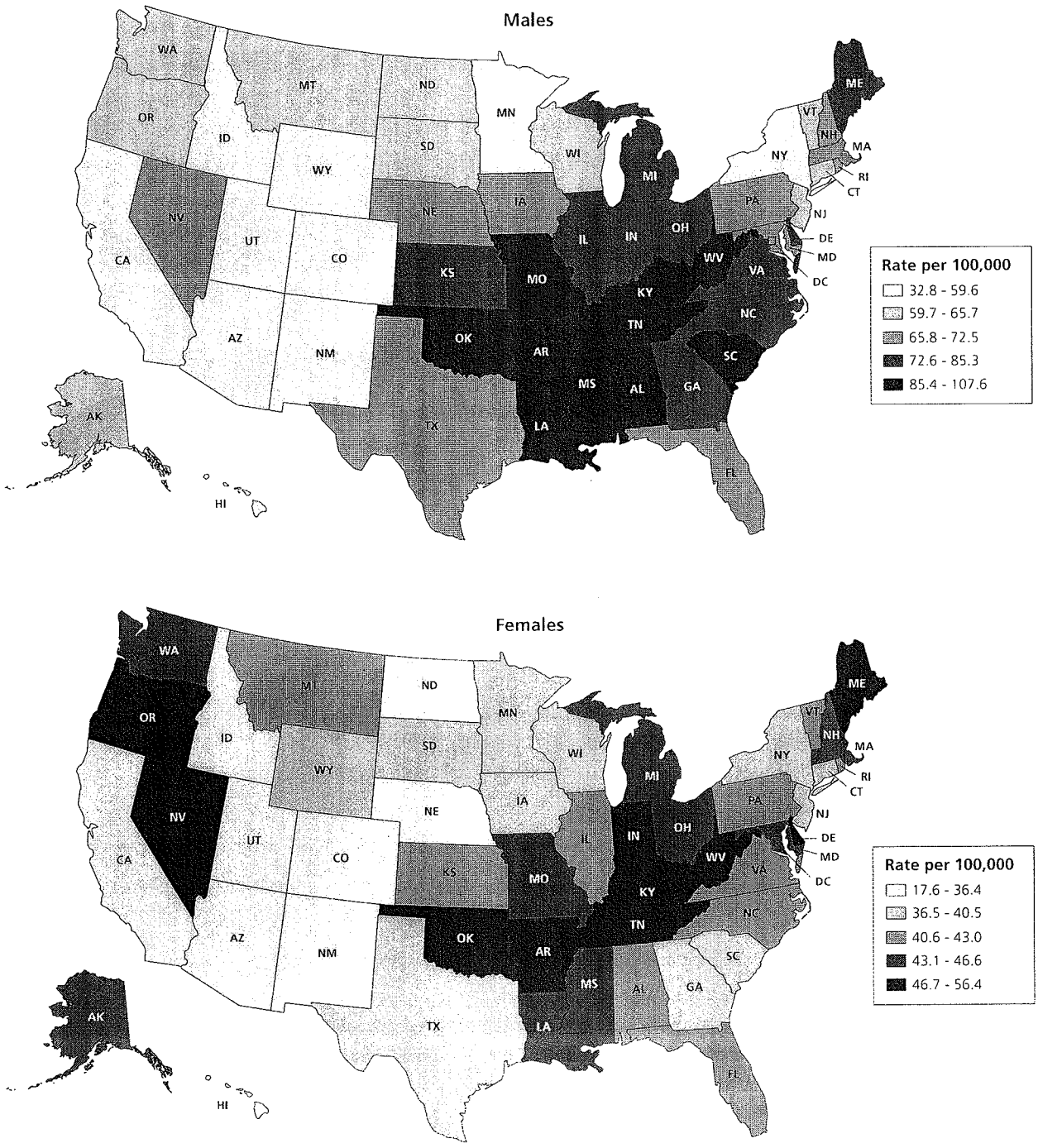
Public Policy

While the causes of cancer disparities are multifaceted, several policy initiatives seek to reduce these disparities. The National Breast and Cervical Cancer Early Detection Program (NBCCEDP), run by the Centers for Disease Control and Prevention (CDC), provides low-income, uninsured women with community-based breast and cervical cancer screening services. Medical assistance and treatment for women diagnosed with cancer through the NBCCEDP are available through Medicaid. The American Cancer Society and its nonprofit, nonpartisan advocacy affiliate, the American Cancer Society Cancer Action Network℠ (ACS CAN), work to maintain and increase funding for this program.

Similarly, ACS CAN supports legislation to create a colorectal cancer screening and treatment program administered by the CDC that will provide medically underserved communities with access to lifesaving screenings for colorectal cancer. The program will focus on low-income, uninsured men and women, as well as those at highest risk, such as African Americans, who are more likely to die of colorectal cancer than any other racial or ethnic group. Efforts also continue to secure funding for the patient navigator demonstration program to help patients navigate through the health care system, from screening to diagnosis and treatment, with culturally and linguistically competent providers and advocates. Legislation for this program was approved in 2005 and received $2.95 million in funding in 2008 and $4 million in 2009; the first round of grants was awarded in September 2008. Efforts continue to secure additional funding needed to implement this important program in communities across the country.

Finally, ACS CAN seeks increased funding for the National Center on Minority Health and Health Disparities (NCMHD) at the National Institutes of Health, along with the Disparities Center at the National Cancer Institute. The NCMHD is leading efforts to determine the causes and extent of cancer and other health disparities and is developing effective interventions to reduce these disparities, as well as exploring methods to facilitate delivery of those interventions. The American Cancer Society is committed to ensuring that all individuals have access to preventive cancer screenings and treatment. Barriers that limit access to preventive services and early detection result in cancer diagnoses at later stages, when the options for treatment and odds of survival are decreased. Opportunities to reduce disparities exist across the entire cancer continuum, from primary prevention to palliative care.

Geographic Patterns in Lung Cancer Death Rates*by State, US, 2002-2006



*Age adjusted to the 2000 US standard population.

Source: Surveillance, Epidemiology, and End Results (SEER) Program (seer.cancer.gov) SEER*Stat Database. Mortality – All COD, Aggregated With State, Total US (1969-2006) <Katrina/Rita Population Adjustment>, National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released May 2009. Underlying mortality data provided by NCHS (cdc.gov/nchs).

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Tobacco Use

Smoking-related diseases remain the world's most preventable cause of death. Since the first US Surgeon General's report on smoking and health in 1964, there have been more than 12 million premature deaths attributable to smoking in the US.[1] The World Health Organization estimates that there are 5.4 million smoking-related premature deaths worldwide each year. The number of smoking-attributable deaths is almost evenly divided between industrialized and developing nations, and is greater in men (80%) than in women. More men die from smoking in developing nations than in industrialized nations.[2,3]

Health Consequences of Smoking

Half of all those who continue to smoke will die from smoking-related diseases.[4] In the US, tobacco use is responsible for nearly 1 in 5 deaths; this equaled an estimated 443,000 premature deaths each year between 2000 and 2004.[5,6] In addition, an estimated 8.6 million people suffer from chronic conditions related to smoking, such as chronic bronchitis, emphysema, and cardiovascular diseases.[7]

- Smoking accounts for at least 30% of all cancer deaths and 87% of lung cancer deaths.[8,9]
- The risk of developing lung cancer is about 23 times higher in male smokers and 13 times higher in female smokers, compared to lifelong nonsmokers.[1]
- Smoking is associated with increased risk of at least 15 types of cancer: nasopharynx, nasal cavity and paranasal sinuses, lip, oral cavity, pharynx, larynx, lung, esophagus, pancreas, uterine cervix, kidney, bladder, stomach, and acute myeloid leukemia.[1]
- Recent studies suggest that smoking may also be associated with cancers of the colorectum, ovary, and female breast.
- Smoking is a major cause of heart disease, cerebrovascular disease, chronic bronchitis, and emphysema, and is associated with gastric ulcers.[1,9]
- The risk of lung cancer is just as high in smokers of "light" or "low-tar" yield cigarettes as in those who smoke "regular" or "full-flavored" products.[10]

Reducing Tobacco Use and Exposure

The US Surgeon General in 2000 outlined the goals and components of comprehensive statewide tobacco control programs.[11] These programs seek to prevent the initiation of tobacco use among youth; promote quitting at all ages; eliminate nonsmokers' exposure to secondhand smoke; and identify and eliminate the disparities related to tobacco use and its effects among different population groups.[12] The Centers for Disease Control and Prevention (CDC) recommends funding levels for comprehensive tobacco use prevention and cessation programs for all 50 states and the District of Columbia. In 2009, only 9 states allocated 50% or more of CDC-recommended funding levels for tobacco control programs.[13] States that have invested in comprehensive tobacco control programs, such as California, Massachusetts, and Florida, have reduced smoking rates and saved millions of dollars in tobacco-related health care costs.[11,14] Recent federal initiatives in tobacco control, including regulation of tobacco products, tax increases, and increased tobacco control funding, hold promise for reducing tobacco use. In June 2009, President Obama signed into law the Family Smoking Prevention and Tobacco Control Act, which for the first time grants the US Food and Drug Administration the authority to regulate the manufacturing, marketing, and sale of tobacco products. Also, in 2009, federal taxes on cigarettes were increased (from $0.39 per pack to slightly more than $1 per pack) as were taxes on other tobacco products (cigars, snuff, and chewing, pipe, and roll-your-own). For more information about tobacco control, see the American Cancer Society's *Cancer Prevention & Early Detection Facts & Figures 2010*, available online at cancer.org/statistics.

Trends in Smoking

- Between 1965 and 2004, cigarette smoking among adults aged 18 and older declined by half from 42% to 21%. Since 2004, smoking rates have changed little; in 2008, an estimated 21% of adults, or 46 million Americans, smoked cigarettes.[15,16]
- Although cigarette smoking became prevalent among men before women, the gender gap narrowed in the mid-1980s and has since remained constant. As of 2008, there was a 3% absolute difference in smoking prevalence between white men (24%) and women (21%), an 8% difference between African American men (26%) and women (18%), a 10% difference between Hispanic men (21%) and women (11%), and an 11% difference between Asian men (16%) and women (5%).[16]
- Smoking is most common among the least educated. While the percentage of smokers has decreased at every level of educational attainment since 1983, college graduates had the greatest decline, from 21% to 9% in 2008. By contrast, among those with a high school diploma, prevalence decreased modestly from 34% to 28% during the same time period.[15] Adults with a GED certificate (high school equivalency diploma) had the highest smoking rate (41%) in 2008, and groups with a high school degree or less quit smoking at lower rates than higher educated groups between 1998 and 2008.[16]
- The decrease in smoking prevalence among high school students between the late 1970s and early 1990s was more rapid among African Americans than whites; consequently, lung cancer rates among adults younger than 40 years, historically substantially higher in African Americans, have converged in these two groups.[17]

- Although cigarette smoking among US high school students increased significantly from 28% in 1991 to 36% in 1997, the rate declined to 20% by 2007.[18,19]
- In 1997, nearly one-half (48%) of male high school students and more than one-third (36%) of female students reported using some form of tobacco – cigarettes, cigars, or smokeless tobacco – in the past month. The percentages declined to 30% for male students and to 21% for female students in 2007.[18,20]

Smokeless Tobacco Products

Smokeless tobacco products include moist snuff, chewing tobacco, snus (a "spitless," moist powder tobacco pouch), dissolvable nicotine products, and a variety of other tobacco-containing products that are not smoked. Tobacco companies are actively promoting these products both for use in settings where smoking is prohibited and as a way to quit smoking; however, there is no evidence that these products are as effective as proven cessation therapies. Use of any smokeless tobacco product is not considered a safe substitute for quitting. These products cause oral and pancreatic cancers, precancerous lesions of the mouth, gum recession, bone loss around the teeth, and tooth staining; they can also lead to nicotine addiction.[21]

- Smokers who use smokeless products as a supplemental source of nicotine to postpone or avoid quitting will increase rather than decrease their risk of lung cancer.[22]
- The risk of cancer of the cheek and gums may be increased nearly 50-fold among long-term snuff users.[21]
- According to the US Department of Agriculture, manufactured output of moist snuff has increased more than 83% in the past two decades, from 48 million pounds in 1991 to an estimated 88 million pounds in 2007.[23,24]
- In 2008, 3.6% of adults 18 and older, 7% of men and 0.3% of women, used smokeless products in the past month. American Indian/Alaska Natives (6%) and whites (5%) were more likely to use smokeless tobacco than African Americans (2 %), Hispanic/Latinos (1%), or Asians (1%).[25]
- Smokeless tobacco use across states varied from 0.2% to 7.2%, with higher rates observed in the South and North-Central states.[26]
- When smokeless tobacco was aggressively marketed in the US in the 1970s, use of these products increased among adolescent males, not among older smokers trying to quit.[27,28] Nationwide, 13% of male high school students were currently using chewing tobacco, snuff, or dip in 2007.[18]

Cigars

Cigar smoking has health consequences similar to those of cigarette smoking and smokeless tobacco.[29]

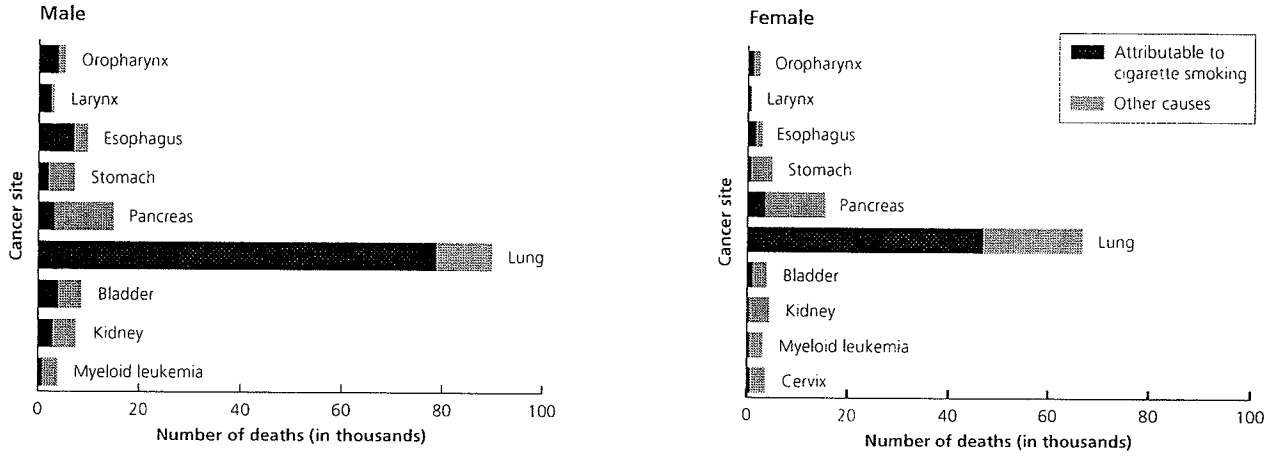
- Regular cigar smoking is associated with an increased risk of cancers of the lung, oral cavity, larynx, esophagus, and probably pancreas. Cigar smokers have 4 to 10 times the risk of dying from laryngeal, oral, or esophageal cancer, compared to nonsmokers.[29]
- While both large and small cigar consumption has increased in the past two decades, since 1998, small cigar consumption has risen at a much faster rate (154%) than large cigar (45%) consumption. Small cigars are similar in shape and size to cigarettes, but are not regulated or taxed like cigarettes, making them more affordable to youth.[30]
- In 2008, 5% of adults aged 18 and older (9% of men and 2% of women) had smoked cigars in the past month. African Americans (8%) and American Indian/Alaska Natives (6%) had the highest prevalence of past-month cigar use, followed by whites (5%), Hispanics (5%), and Asians (1%).[25]
- Among states, cigar-smoking prevalence among adults ranges from between 2.2% to 5.4%.[26]
- In 2007, 14% of US high school students had smoked cigars, cigarillos, or little cigars at least once in the past 30 days.[18]

Smoking Cessation

A US Surgeon General's report outlined the benefits of smoking cessation:[31]

- People who quit, regardless of age, live longer than people who continue to smoke.
- Smokers who quit before age 50 cut their risk of dying in the next 15 years in half, compared to those who continue to smoke.
- Quitting smoking substantially decreases the risk of lung, laryngeal, esophageal, oral, pancreatic, bladder, and cervical cancers.
- Quitting lowers the risk for other major diseases, including heart disease and stroke.
- In 2008, an estimated 48.1 million adults were former smokers, representing 51% of persons who ever smoked.[16]
- Between 1998 and 2008, rates of adult smoking cessation remained stable overall.
- Smokers with an undergraduate or graduate degree are more likely to quit than less educated smokers, probably because of greater understanding of the health hazards of smoking.[16]
- Among those who smoked in 2008, an estimated 20.8 million (or 45%) had stopped smoking at least one day during the preceding 12 months because they were trying to quit.[16]
- In 42 states and the District of Columbia, the majority of adults (50% or more) who ever smoked have quit smoking. Across states, between 52% and 67% of adult smokers tried to quit smoking in the past year, but these proportions were significantly lower among adults with less than a high school education (17% to 51%).[32]

Annual Number of Cancer Deaths Attributable to Smoking by Sex and Site, US, 2000-2004



Source: Centers for Disease Control and Prevention. Smoking-attributable mortality, years of potential life lost, and productivity losses – United States, 2000-2004. *MMWR Morb Mortal Wkly Rep.* 2008;57(45):1226-1228.

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- In 2007, among high school students who were current cigarette smokers, national data showed that one-half (50%) had tried to quit smoking cigarettes during the 12 months preceding the survey; female students (55%) were more likely to have made a quit attempt than male students (45%).[18]
- Tobacco dependence is a chronic disease and should be treated with effective treatments that may double or triple smokers' chances of long-term abstinence.[33] Certain racial and ethnic groups (Hispanics and non-Hispanic African Americans) and those with low socioeconomic status are significantly less likely to receive cessation services.[26] Improving access to these services by promoting coverage for these treatments through government health programs, including Medicaid and Medicare, and private health insurance mandates can help reduce these disparities.

Secondhand Smoke

Secondhand smoke (SHS), or environmental tobacco smoke, contains numerous human carcinogens for which there is no safe level of exposure. It is estimated that more than 126 million nonsmoking Americans are exposed to SHS in homes, vehicles, workplaces, and public places.[34] Numerous scientific consensus groups have reviewed data on the health effects of SHS.[34-39] In 2006, the US Surgeon General published a comprehensive report titled *The Health Consequences of Involuntary Exposure to Tobacco Smoke.*[34] Public policies to protect people from SHS are based on the following detrimental effects:

- SHS contains more than 4,000 substances, more than 50 of which are known or suspected to cause cancer in humans and animals, and many of which are strong irritants.[37]
- Each year, about 3,400 nonsmoking adults die of lung cancer as a result of breathing SHS.[6]
- SHS causes an estimated 46,000 deaths from heart disease in people who are not current smokers.[6]
- SHS may cause coughing, wheezing, chest tightness, and reduced lung function in adult nonsmokers.[34]
- Some studies have reported an association between SHS exposure and breast cancer. The US Surgeon General has designated this evidence suggestive rather than conclusive.[34] In any case, women should be aware that there are many health reasons to avoid exposure to tobacco smoke.

Laws that prohibit smoking in public places and create smoke-free environments are the most effective approach to prevent exposure to – and harm from – SHS. An additional benefit of smoke-free policies is the modification of smoking behaviors among current smokers. Momentum to regulate public smoking began to increase in 1990, and these laws have become increasingly common and comprehensive.[40]

- Exposure to SHS among nonsmokers, as measured by detectable levels of cotinine (a metabolite of nicotine), declined from 84% in 1988-1994 to 46% in 1999-2004.[41]
- Presently in the US, more than 3,079 municipalities (as of January 2010) have passed smoke-free legislation and 35 states, the District of Columbia, and Puerto Rico have either implemented or enacted statewide smoking bans that prohibit smoking in workplaces and/or restaurants and/or bars.[42]
- Currently, approximately 74% of the US population is covered by a smoke-free policy or provision in workplaces and/or restaurants and/or bars.[42]

- Nationally, coverage of all indoor workers by smoke-free policies increased substantially from 1992-1993 (46%) to 2006-2007 (75%).[43]
- Workplace smoking restrictions vary by geographic area; 72% of Southern residents reported working under a smoke-free policy, compared to 81% of workers in the Northeast. [44]
- In addition to providing protection against harmful exposure to secondhand smoke, there is strong evidence that smoke-free policies decrease the prevalence of both adult and youth smoking.[45]

Costs of Tobacco

The number of people who die prematurely or suffer illness from tobacco use impose substantial health-related economic costs to society. It is estimated that in the US, between 2000 and 2004, smoking accounted for 3.1 million years of potential life lost in men and 2.0 million years of potential life lost in women. Smoking, on average, reduces life expectancy by approximately 14 years.[6]

In addition:

- Between 2001 and 2004, smoking, on average, resulted in more than $193 billion in annual health-related economic costs in the US, including smoking-attributable medical economic costs and productivity losses.[6]
- During 2001-2004, average annual smoking-attributable health care expenditures were an estimated $96 billion, up $20 billion from $76 billion in 1998.[6, 46]
- Smoking-attributable productivity losses in the US amounted to $96.8 billion annually during 2000-2004, up about $4.3 billion from the $92 billion lost annually during 1997-2001.[6, 47]

Worldwide Tobacco Use

During the past 25 years, while the prevalence of smoking has been slowly declining in the US and many other high-income countries, smoking rates have been increasing in many low- and middle-income nations, where about 85% of the world population resides.

- Low-income countries consume an increasing proportion of the world's tobacco due to population growth and tobacco industry targeting. By 2030, more than 80% of the world's tobacco-related deaths will be in low- and middle-income countries.[48]
- In 2003, the number of smokers in the world was estimated at about 1.3 billion (more than 1 billion men and 250 million women). This figure is expected to rise to at least 1.7 billion (1.2 billion men and 500 million women) by 2025, with the doubling in the number of female smokers making the greatest contribution to the increase.[2, 19]
- Female smoking prevalence rates have peaked and are decreasing in most high-income countries, such as Australia, Canada, the United Kingdom, and the US; however, in many countries female smoking rates are still increasing or show no evidence of decline.[2] Female smoking rates in developing nations are expected to converge with those of developed nations at 20%-25% by 2030.[50, 51]
- In 2010, tobacco will kill about 6 million people worldwide, 72% of whom reside in low- and middle-income countries.[2]
- Based on current patterns, smoking-attributable diseases will kill as many as 650 million of the world's 1.3 billion smokers alive today.[52, 53] Deaths from tobacco are projected to decline by 9% between 2002-2030 in high-income countries, but to double from 3.4 million to 6.8 million in low- and middle-income countries in the same time period.[54]
- Data from the Global Youth Tobacco Survey conducted during 2000-2007 found that among youth aged 13 to 15 years, 12% of boys and 7% of girls reported smoking cigarettes, and 12% of boys and 8% of girls reported using other tobacco products.[55] In every region of the world, the ratio of male to female smoking among youth was smaller than the ratio reported among adults, reflecting a global trend of increased smoking among female youth.[56]

The first global public health treaty, the Framework Convention on Tobacco Control (FCTC), was unanimously adopted by the World Health Assembly on May 21, 2003, and subsequently entered into force as a legally binding accord for all ratifying states on February 27, 2005.[57] The FCTC features specific provisions to control both the global supply and demand for tobacco, including regulation of tobacco product contents, packaging, labeling, advertising, promotion, sponsorship, taxation, smuggling, youth access, exposure to secondhand tobacco smoke, and environmental and agricultural impacts.[57] Parties to the treaty are expected to strengthen national legislation, enact effective tobacco control policies, and cooperate internationally to reduce global tobacco consumption.[58] As of November 2009, out of 195 eligible countries, 183 have signed the FCTC and 168 have ratified the treaty.[57] A number of major tobacco-producing nations, including Argentina, Indonesia, Malawi, the US, and Zimbabwe, have not ratified the treaty.[57]

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Nutrition and Physical Activity

It's been estimated that approximately one-third of the cancer deaths that occur in the US each year are due to poor nutrition and physical inactivity, including excess weight. Eating a healthy diet, being physically active on a regular basis, and maintaining a healthy body weight are as important as not using tobacco products in reducing cancer risk. Published in 2006, the American Cancer Society's most recent guidelines emphasize the importance of weight control, physical activity, and dietary patterns in reducing cancer risk and helping people stay well; unfortunately, the majority of Americans are not meeting these recommendations. Increasing trends in unhealthy eating and physical inactivity – and resultant increases in overweight and obesity – have largely been influenced by the environments in which people live, learn, work, and play. As a result, the guidelines include an explicit Recommendation for Community Action to promote the availability of healthy food choices and opportunities for physical activity in schools, workplaces, and communities.

The following recommendations reflect the best nutrition and physical activity evidence available to help Americans reduce their risk not only of cancer, but also of heart disease and diabetes.

Recommendations for Individual Choices

1. Maintain a healthy weight throughout life.

- Balance caloric intake with physical activity.
- Avoid excessive weight gain throughout life.
- Achieve and maintain a healthy weight if currently overweight or obese.

In the US, overweight and obesity contribute to 14%-20% of all cancer-related mortality. Overweight and obesity are clearly associated with increased risk for developing many cancers, including cancers of the breast in postmenopausal women, colon, endometrium, kidney, and adenocarcinoma of the esophagus. Evidence is highly suggestive that obesity also increases risk for cancers of the pancreas, gallbladder, thyroid, ovary, and cervix, as well as for myeloma, Hodgkin lymphoma, and aggressive forms of prostate cancer. Increasing evidence also suggests that being overweight increases the risk for cancer recurrence and decreases the likelihood of survival for many cancers. Recent studies suggest that losing weight may reduce the risk of breast cancer. In addition, some studies have shown that surgery to treat morbid obesity reduces mortality from major chronic diseases, including cancer. Although knowledge about the relationship between weight loss and cancer risk is incomplete, individuals who are overweight should be encouraged and supported in their efforts to reduce weight.

At the same time that evidence connecting excess weight to increased cancer risk has been accumulating, trends in overweight and obesity have been increasing. The prevalence of obesity in the US more than doubled between 1976-1980 and 2003-2004. Although rates appear to have stabilized in the most recent time period (2005-2006), more than one-third of adults – more than 72 million people – are currently obese. These trends are likely already impacting cancer trends: in the midpoint assessment of its 2015 Challenge Goals, American Cancer Society researchers reported that while the incidence of both colorectal cancer and post-menopausal breast cancer had been declining, it is likely that the declines in both would have started earlier and would have been steeper had it not been for the increasing prevalence of obesity.

Similar to adults, obesity among adolescents has tripled over the past several decades. Increases occurred across race, ethnicity, and gender. As in adults, obesity prevalence stabilized between 2003-2004 and 2005-2006. Because overweight in youth tends to continue throughout life, efforts to establish healthy body weight patterns should begin in childhood. The increasing prevalence of overweight and obesity in preadolescents and adolescents may increase incidence of cancer in the future.

2. Adopt a physically active lifestyle.

- Adults: Engage in at least 30 minutes of moderate to vigorous physical activity, in addition to usual activities, on 5 or more days of the week. Forty-five to 60 minutes of intentional physical activity is preferable.
- Children and adolescents: Engage in at least 60 minutes per day of moderate to vigorous physical activity at least 5 days per week.

Living a physically active lifestyle is important to reduce the risk of a variety of types of cancer, as well as heart disease and diabetes. Physical activity is associated with a 20% to 30% reduction in the risk of colon cancer. Studies also show that physical activity reduces the risk of breast cancer, especially vigorous activity. Physical activity also indirectly reduces the risk of developing the many types of obesity-related cancers because of its role in helping to maintain a healthy weight. Being active is thought to reduce cancer risk largely by improving energy metabolism and reducing circulating concentrations of estrogen, insulin, and insulin-like growth factors. Physical activity also improves the quality of life of cancer patients and is associated with a reduction in the risk of breast cancer recurrence, breast cancer-specific mortality, and all-cause mortality.

Despite the wide variety of health benefits from being active, 24% of adults report no leisure-time activity, and only 49% meet minimum recommendations for moderate activity. Similarly, only 35% of youth meet recommendations.

3. Consume a healthy diet with an emphasis on plant sources.

- Choose foods and beverages in amounts that help achieve and maintain a healthy weight.
- Eat 5 or more servings of a variety of vegetables and fruits each day.
- Choose whole grains in preference to processed (refined) grains.
- Limit consumption of processed and red meats.

There is strong scientific evidence that healthy dietary patterns, in combination with regular physical activity, are needed to maintain a healthy body weight and to reduce cancer risk. Many epidemiologic studies have shown that populations that eat diets high in vegetables and fruits and low in animal fat, meat, and/or calories have reduced risk of some of the most common cancers. Moreover, evidence that a diet high in red and processed meats is associated with a higher risk of developing gastrointestinal cancers has increased over the years. Despite the known benefits of a healthy diet, Americans are not following recommendations. According to the US Department of Agriculture, the majority of Americans would need to substantially lower their intake of added fats, refined grains, sodium and added sugars, and increase their consumption of fruits, vegetables, whole grains, and low-fat dairy products in order to meet the 2005 Dietary Guidelines for Americans.

At this time, individual nutritional supplements are not recommended for cancer prevention, as the results of recently completed randomized clinical trials of antioxidant supplements and selenium have shown no reduction in risk for cancer, at least in generally well-nourished populations. Results from ongoing studies of other nutrients, including calcium and vitamin D, are awaited before any recommendations can be made.

The scientific study of nutrition and cancer is highly complex, and many important questions remain unanswered. It is not presently clear how single nutrients, combinations of nutrients, over-nutrition, and energy imbalance, or the amount and distribution of body fat at particular stages of life affect a person's risk of specific cancers. Until more is known about the specific components of diet that influence cancer risk, the best advice is to consume a mostly plant-based diet emphasizing a variety of vegetables, fruits, and whole grains, while limiting red and processed meats. A special emphasis should be placed on controlling total caloric intake to help achieve and maintain a healthy weight.

4. If you drink alcoholic beverages, limit consumption.

People who drink alcohol should limit their intake to no more than two drinks per day for men and one drink per day for women. Alcohol consumption is an established cause of cancers of the mouth, pharynx, larynx, esophagus, liver, and breast. For each of these cancers, risk increases substantially with the intake of more than two drinks per day. Regular consumption of even a few drinks per week has been associated with an increased risk of breast cancer in women. The mechanism for how alcohol can affect breast cancer is not known with certainty, but it may be due to alcohol-induced increases in circulating estrogen or other hormones in the blood, reduction of folic acid levels, or a direct effect of alcohol or its metabolites on breast tissue. Alcohol consumption combined with tobacco use increases the risk of cancers of the mouth, larynx, and esophagus far more than either drinking or smoking alone.

The American Cancer Society's Recommendation for Community Action

While many Americans would like to adopt a healthy lifestyle, many encounter substantial barriers that make it difficult to make healthy food and physical activity choices. Increased portion sizes, especially of restaurant meals; marketing and advertising of foods and beverages high in calories, fat, and added sugar, particularly to kids; schools and worksites that are not conducive to good health; community design that hinders physical activity; economic and time constraints, as well as other influences, have collectively contributed to increasing trends in obesity.

Because of the tremendous influence that the surrounding environment has on individual food and activity choices, the Society's nutrition and physical activity guidelines include a Recommendation for Community Action. Acknowledging that to turn the obesity trends around will require extensive policy and environmental changes, the Society calls for public, private, and community organizations to create social and physical environments that support the adoption and maintenance of healthy nutrition and physical activity behaviors to help people stay well. This includes implementing strategies that increase access to healthy foods in schools, workplaces, and communities, and that provide safe, enjoyable, and accessible environments for physical activity in schools and for transportation and recreation in communities.

Achieving this Recommendation for Community Action will require multiple strategies and bold action, ranging from the implementation of community and workplace health promotion programs to policies that affect community planning, transportation, school-based physical education, and food services.

The Centers for Disease Control and Prevention (CDC), the Institute of Medicine, the World Health Organization (WHO), and others have outlined a variety of evidenced-based approaches in schools, worksites, and communities to halt and ultimately turn around the obesity trends. Following are some specific approaches that have been proposed:

- Limit the availability, advertising, and marketing of foods and beverages of low nutritional value, particularly in schools.
- Strengthen nutrition standards in schools for foods and beverages served as part of the school meals program and for competitive foods and beverages served outside of the program.
- Increase and enforce physical education requirements in grades K-12.
- Ensure that worksites have healthy food and beverage options and that physical environments are designed or adapted and maintained to facilitate physical activity and weight control.
- Encourage restaurants to provide nutrition information on menus, especially calories.
- Invest in community design that supports development of sidewalks, bike lanes, and access to parks and green space.

The tobacco control experience has shown that policy and environmental changes at the national, state, and local levels are critical to achieving changes in individual behavior. Measures such as clean indoor air laws and increases in cigarette excise taxes are highly effective in deterring tobacco use. To avert an epidemic of obesity-related disease, similar purposeful changes in public policy and in the community environment will be required to help individuals maintain a healthy body weight and remain physically active throughout life.

Environmental Cancer Risks

Two major classes of factors influence the incidence of cancer: hereditary factors and acquired (environmental) factors. Hereditary factors come from our parents and cannot be modified. Environmental factors, which include behavioral choices, are potentially modifiable. They include tobacco use, poor nutrition, physical inactivity, obesity, certain infectious agents, certain medical treatments, excessive sun exposure, and exposures to carcinogens (cancer-causing agents) that exist as pollutants in our air, food, water, and soil. Some carcinogens occur naturally, and some are created or concentrated by human activity. Radon, for example, is a naturally occurring carcinogen present in soil and rock; however, occupational exposure occurs in underground mines and substantial exposures also occur in poorly ventilated basements in regions where radon soil emissions are high. Environmental (as opposed to hereditary) factors account for an estimated 75%-80% of cancer cases and deaths in the US. Exposure to carcinogenic agents in occupational, community, and other settings is thought to account for a relatively small percentage of cancer deaths, about 4% from occupational exposures and 2% from environmental pollutants (man-made and naturally occurring). Although the estimated percentage of cancers related to occupational and environmental carcinogens is small compared to the cancer burden from tobacco smoking (30%) and the combination of nutrition, physical activity, and obesity (35%), the relationship between such agents and cancer is important for several reasons. First, even a small percentage of cancers can represent many deaths: 6% of cancer deaths in the US in 2010 corresponds to approximately 34,000 deaths. Second, the burden of exposure to occupational and environmental carcinogens is borne disproportionately by lower-income workers and communities, contributing to disparities in the cancer burden across the population. Third, although much is known about the relationship between occupational and environmental exposure and cancer, some important research questions remain. These include the role of exposures to certain classes of chemicals (such as hormonally active agents) during critical periods of human development and the potential for pollutants to interact with each other, as well as with genetic and acquired factors.

How Carcinogens Are Identified

The term carcinogen refers to exposures that can increase the incidence of malignant tumors (cancer). The term can apply to a single chemical such as benzene; fibrous minerals such as asbestos; metals and physical agents such as x-rays or ultraviolet

light; or exposures linked to specific occupations or industries (e.g., nickel refining). Carcinogens are usually identified on the basis of epidemiological studies or by testing in animals. Studies of occupational groups (cohorts) have played an important role in understanding many chemical carcinogens – as well as radiation – because exposures are often higher among workers, who can be followed for long periods of time. Some information has also come from studies of persons exposed to carcinogens during medical treatments (such as radiation and estrogen), as well as from studies conducted among individuals who experienced large, short-term exposure to a chemical or physical agent due to an accidental or intentional release (such as survivors of the atomic bomb explosions of Hiroshima and Nagasaki). It is more difficult to study the relationship between exposure to potentially carcinogenic substances and cancer risk in the general population because of uncertainties about exposure and the challenge of long-term follow-up. Moreover, relying upon epidemiological information to determine cancer risk does not fulfill the public health goal of prevention since, by the time the increased risk is detected, a large number of people may have been exposed. Thus, for the past 40 years, the US and many other countries have developed methods for identifying carcinogens through animal testing using the "gold standard" of a 2-year or lifetime bioassay in rodents. This test is expensive and time-consuming, but it can provide information about potential carcinogens so that human exposure can be reduced or eliminated. Many substances that are carcinogenic in rodent bioassays have not been adequately studied in humans, usually because an acceptable study population has not been identified. Among the substances that have proven carcinogenic in humans, all have shown positive results in animals when tested in well-conducted 2-year bioassays.[1]

Moreover, between 25%-30% of established human carcinogens were first identified through animal bioassays. Since animal tests necessarily use high-dose exposures, human risk assessment usually requires extrapolation of the exposure-response relationship observed in rodent bioassays to predict effects in humans at lower doses.

Typically, regulatory agencies in the US and abroad have adopted the default assumption that no threshold level (level below which there is no increase in risk) of exposure exists for carcinogenesis.

Evaluation of Carcinogens

The National Toxicology Program (NTP) plays an important role in the identification and evaluation of carcinogens in the US, and the International Agency for Research on Cancer (IARC) plays a similar role internationally. The National Toxicology Program was established in 1978 to coordinate toxicology testing programs within the federal government, including tests for carcinogenicity. The NTP is also responsible for producing the Report on Carcinogens, an informational scientific and public health document that identifies agents, substances, mixtures, or exposure circumstances that may increase the risk of developing cancer.[2] For a list of substances listed in the *11th Report on Carcinogens* as known or reasonably anticipated to be human carcinogens, see ntp.niehs.nih.gov/ntp/roc/toc11.html. The IARC is a branch of the World Health Organization that regularly convenes scientific consensus groups to evaluate potential carcinogens. After reviewing published data from laboratory, animal, and human research, these committees reach consensus about whether the evidence should be designated "sufficient," "limited," or "inadequate" to conclude that the substance is a carcinogen. For a list of substances that have been reviewed by the IARC monograph program, visit monographs.iarc.fr/ENG/Publications/internrep/07-001.pdf. The American Cancer Society does not have a formal program to review and evaluate carcinogens. However, information on selected topics can be found at cancer.org.

Although the relatively small risks associated with low level exposure to carcinogens in air, food, or water are difficult to detect in epidemiological studies, scientific and regulatory bodies throughout the world have accepted the principle that it is reasonable and prudent to reduce human exposure to substances shown to be carcinogenic at higher levels of exposure. Although much public concern about the influence of man-made pesticides and industrial chemicals has focused on cancer, pollution may adversely affect the health of humans and ecosystems in many other ways. Research to understand the short- and long-term impact of environmental pollutants on a broad range of outcomes, as well as regulatory actions to reduce exposure to recognized hazards, has contributed to the protection of the public and the preservation of the environment for future generations. It is important that this progress be recognized and sustained. For more information on environmental cancer risks, see the article published by Fontham et al. in the November/December issue of *CA: A Cancer Journal for Clinicians*.[3]

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The Global Fight against Cancer

The ultimate mission of the American Cancer Society is to eliminate cancer as a major health problem. Because cancer knows no boundaries, this mission extends around the world.

Cancer is an enormous global health burden, touching every region and socioeconomic level. Today, cancer accounts for one in every eight deaths worldwide – more than HIV/AIDS, tuberculosis, and malaria combined. In 2008, there were an estimated 12.4 million cases of cancer diagnosed and 7.6 million deaths from cancer around the world. People living in low- and middle-income countries are especially hard hit by cancer. More than 70 percent of all cancer deaths occur in these countries, many of which lack the medical resources and health systems to handle the disease burden.

The global cancer burden is growing at an alarming pace. The World Health Organization (WHO) projects that in 2010, cancer will become the leading cause of death globally, surpassing heart disease and stroke. The WHO also projects that by 2030, the number of deaths caused by cancer will grow to 12 million per year. Much of the growth of the global cancer burden will occur in low- and middle-income countries, where cancer incidence and death rates are rising rapidly.

The growing cancer burden is being driven largely by two developments: the increasing adoption of unhealthy lifestyle behaviors and the growth and aging of populations. Today, most cancers are linked to a few controllable factors, including tobacco use, poor diet, lack of exercise, and infectious diseases. Tobacco use is the most preventable cause of death worldwide, responsible for the deaths of approximately half of long-term users. Tobacco use killed 100 million people in the 20th century and, if current trends continue, will kill 1 billion people in the 21st century. In 2010, tobacco will kill 6 million people, 72% of whom will be in low- and middle-income countries. The percentage is expected to increase to 83% by 2030.

With nearly a century of experience in cancer control, the American Cancer Society is uniquely positioned to lead the global fight against cancer and tobacco, assisting and empowering the world's cancer societies and anti-tobacco advocates. The Society's global health program is working to raise awareness about the growing global cancer burden and to promote evidence-based cancer and tobacco control programs.

The American Cancer Society conducts global cancer and tobacco control activities with three overarching goals:

- **Make cancer control and tobacco control political and public health priorities.** The Society supports studies on cancer and tobacco related to development in low- and middle-income countries, and conveys global cancer information and awareness through global cancer control publications in both scientific journals and the popular press. The Society promotes the inclusion of cancer and other chronic diseases on public health agendas of global political and economic organizations. The Society also collaborates with major multilateral, bilateral, corporate, and nongovernmental stakeholders on cancer and tobacco control, including the World Health Organization, the International Union Against Cancer, the Lance Armstrong Foundation, and the Bill & Melinda Gates Foundation.
- **Increase tobacco taxes globally.** The Society supports tobacco tax campaigns that create new national tobacco taxes in low- and middle-income countries and helps those countries commit to assigning at least 10 percent of tobacco tax revenues to tobacco control activities.
- **Create smoke-free workplaces and public places globally.** The Society works with the Global Smokefree Partnership to support smoke-free campaigns for new legislation in countries worldwide. The Society also supports studies on smoke-free workplaces and public places.

The Society strives to achieve these goals through a variety of programs, such as training and seed grants for cancer and tobacco control advocates, training for journalists on health reporting, partnerships with global cancer control organizations, and participation in major global public health conferences.

In addition to print publications, the American Cancer Society provides cancer information to millions of individuals throughout the world on its Web site, cancer.org. More than 20% of the visitors to the Web site come from outside the US. Information is currently available in English, Spanish, Mandarin, and several other Asian languages.

For more information on the global cancer burden, visit the Society's global health program Web site at cancer.org/international. Also, see the following publications available on cancer.org:

- *Global Cancer Facts & Figures 2007*
- *The Tobacco Atlas, Third Edition*
- *The Cancer Atlas*

The American Cancer Society

In 1913, 10 physicians and five laypeople founded the American Society for the Control of Cancer. Its purpose was to raise awareness about cancer symptoms, treatment, and prevention; to investigate what causes cancer; and to compile cancer statistics. Later renamed the American Cancer Society, Inc., the organization now works with its more than 3 million volunteers to save lives and create a world with less cancer and more birthdays by helping people stay well, helping people get well, by working to find cures, and by fighting back against the disease. Thanks to this important work, the Society is making remarkable progress in cancer prevention, early detection, treatment, and patient quality of life. The overall cancer death rate has steadily declined since the early 1990s, and the 5-year survival rate is now 68%, up from 50% in the 1970s. Thanks to this progress, more than 11 million cancer survivors in the US will celebrate another birthday this year.

How the American Cancer Society Is Organized

The American Cancer Society consists of a National Home Office with 13 chartered Divisions and a local presence in nearly every community nationwide.

The National American Cancer Society

A National Assembly of volunteer representatives from each of the American Cancer Society's 13 Divisions approves Division charters and elects a national volunteer Board of Directors and the nominating committee. In addition, the Assembly approves corporate bylaw changes and the organization's division of funds policy. The Board of Directors sets and approves strategic goals for the Society, ensures management accountability, approves Division charters and charter requirements, and provides stewardship of donated funds. The National Home Office is responsible for overall planning and coordination of the Society's programs, provides technical support and materials to Divisions and local offices, and administers the Society's research program.

American Cancer Society Divisions

The Society's 13 Divisions are responsible for program delivery and fundraising in their regions. They are governed by Division Boards of Directors composed of both medical and lay volunteers in their regions.

Local Offices

The Society has a presence in nearly every community nationwide, with local offices responsible for raising funds at the community level and delivering programs that help people stay well and get well from cancer, as well as rally communities to fight back against the disease.

Volunteers

More than 3 million volunteers carry out the Society's work in communities across the country. These dedicated people donate their time and talents in many ways to create a world with less cancer and more birthdays. Some volunteers choose to educate people about things they can do to prevent cancer or find it early to stay well. Some choose to offer direct support to patients, like driving them to treatment or providing guidance and emotional support. Others work to make cancer a top priority for lawmakers and participate in local community events to raise funds and awareness to fight cancer. No matter how volunteers choose to fight back, they are all saving lives while fulfilling their own.

How the American Cancer Society Saves Lives

The American Cancer Society has set aggressive challenge goals to dramatically decrease cancer incidence and mortality rates by 2015 while increasing the quality of life for all cancer survivors. The Society is uniquely qualified to make a difference in the fight against cancer and save more lives by continuing its leadership position in supporting high-impact research; improving the quality of life for those affected by cancer; preventing and detecting cancer; and reaching more people, including the medically underserved, with the reliable cancer-related information they need. Simply stated, the American Cancer Society saves lives by helping people stay well and get well, by finding cures, and by fighting back against cancer.

Helping People Stay Well

The American Cancer Society helps everyone stay well by taking steps to prevent cancer or find it early, when it is most treatable.

Prevention

The Society helps people quit tobacco through the American Cancer Society Quit For Life® Program, operated by Free & Clear®. The program has helped more than one million tobacco users make a plan to quit for good through its telephone-based coaching and Web-based learning support service.

The Society's guidelines for proper nutrition, physical activity, and cancer screenings help doctors and people across the nation understand how to reduce cancer risk and what tests they need to find cancer at its earliest, most treatable stage. The Society can help people create a personalized health action plan based

on their age and gender and provide individualized cancer screening and healthy lifestyle recommendations, along with the tips, tools, and online resources to help people stay motivated to eat healthy and maintain an active lifestyle.

The Society offers many programs to companies to help their employees stay well and reduce their cancer risk. These include Choose to Change℠, a program in which trained counselors help employees achieve and maintain a healthy weight by making lasting changes in their lives; Freshstart®, a group-based tobacco cessation counseling program designed to help employees plan a successful quit attempt by providing essential information, skills for coping with cravings, and group support; and Active For Life®, a 10-week online program that uses individual and group strategies to help employees become more physically active.

Across the nation, the Society works with its nonpartisan advocacy affiliate, the American Cancer Society Cancer Action Network℠ (ACS CAN), to create healthier communities by protecting people from the dangers of secondhand smoke so they can stay well. As of January, 2010, 41% of the US population was covered by comprehensive smoke-free laws and 74% was covered by at least one law. In 2009, the Family Smoking Prevention and Tobacco Control Act was signed into law. The tobacco bill grants the Food and Drug Administration power over the sale, production, and marketing of cigarettes and other tobacco products, legislation that will save lives and help protect children from the dangers of tobacco.

For the majority of Americans who do not smoke, the most important ways to reduce cancer risk are to maintain a healthy weight, be physically active on a regular basis, and eat a mostly plant-based diet that limits saturated fat. The Society publishes guidelines on nutrition and physical activity for cancer prevention in order to review the accumulating scientific evidence on diet and cancer; to synthesize this evidence into clear, informative recommendations for the general public; to promote healthy individual behaviors, as well as environments that support healthy eating and physical activity habits; and, ultimately, to reduce cancer risk. These guidelines form the foundation for the Society's communication, worksite, school, and community strategies designed to encourage and support people in making healthy lifestyle behavior changes.

Early Detection

Finding cancer at its earliest, most treatable stage gives patients the greatest chance of survival. To help the public and health care providers make informed decisions about cancer screening, the American Cancer Society publishes a variety of early detection guidelines. These guidelines are assessed regularly to ensure that recommendations are based on the most current scientific evidence.

The Society currently provides screening guidelines for cancers of the breast, cervix, colorectum, prostate, and endometrium, and general recommendations for a cancer-related component of a periodic checkup to examine the thyroid, mouth, skin, lymph nodes, testicles, and ovaries.

Throughout its history, the American Cancer Society has implemented a number of aggressive awareness campaigns targeting the public and health care professionals. Campaigns to increase usage of Pap testing and mammography have contributed to a 70% decrease in cervical cancer incidence rates since the introduction of the Pap test in the 1950s and a steady decline in breast cancer mortality rates since 1990. In the past 5 years, the Society has launched ambitious multimedia campaigns to encourage adults aged 50 and older to get tested for colorectal cancer. The Society also continues to encourage the early detection of breast cancer through public awareness and other efforts targeting poor and underserved communities.

Helping People Get Well

For almost 1.5 million cancer patients diagnosed this year and more than 11 million US cancer survivors, the American Cancer Society is here every minute of every day and night to offer free information, programs, services, and community referrals to patients, survivors, and caregivers through every step of a cancer experience. These resources are designed to help people facing cancer on their journey to getting well.

Information, 24 Hours a Day, Seven Days a Week

The American Cancer Society is available 24 hours a day, seven days a week online at cancer.org and by calling the Society's National Cancer Information Center at 1-800-227-2345. Callers are connected with a Cancer Information Specialist who can help them locate a hospital, understand cancer and treatment options, learn what to expect and how to plan, help address insurance concerns, find financial resources, find a local support group, and more. The Society can also help people who speak languages other than English or Spanish find the assistance they need, offering services in 170 languages in total.

Information on every aspect of the cancer experience, from prevention to survivorship, is also available through the Society's Web site, cancer.org. The site includes an interactive cancer resource center containing in-depth information on every major cancer type. The Society also publishes a wide variety of pamphlets and books that cover a multitude of topics, from patient education, quality-of-life, and caregiving issues to healthy living. A complete list of Society books is available for order at cancer.org/bookstore.

The Society publishes a variety of information sources for health care providers, including three clinical journals: *Cancer*, *Cancer Cytopathology*, and *CA: A Cancer Journal for Clinicians*. More

information about free subscriptions and online access to *CA* and *Cancer Cytopathology* articles is available at cancer.org/journals. The American Cancer Society also collaborates with numerous community groups, nationwide health organizations, and large employers to deliver health information and encourage Americans to adopt healthy lifestyle habits through the Society's science-based worksite programs.

Day-to-day Help and Emotional Support

The American Cancer Society can help cancer patients and their families find the resources they need to overcome the day-to-day challenges that can come from a cancer diagnosis, such as transportation to and from treatment, financial and insurance needs, and lodging when having to travel far from home for treatment. The Society also connects people with others who have been through similar experiences to offer emotional support.

Help with the health care system: Learning how to navigate the cancer journey and the health care system can be overwhelming for anyone, but it is particularly difficult for those who are medically underserved, those who experience language or health literacy barriers, or those with limited resources. The American Cancer Society Patient Navigator Program was designed to reach those most in need. As the largest oncology-focused patient navigator program in the country, the Society has specially trained patient navigators at 140 cancer treatment facilities across the nation. Patient navigators work in cooperation with these facilities' staff to connect patients with information, resources, and support to decrease barriers and ultimately to improve health outcomes. The Society collaborates with a variety of organizations, including the National Cancer Institute's Center to Reduce Cancer Health Disparities, the Center for Medicare and Medicaid Services, numerous cancer treatment centers, and others to implement and evaluate this program.

Transportation to treatment: Cancer patients cite transportation to and from treatment as a critical need, second only to direct financial assistance. Through its Road to Recovery® program, the American Cancer Society matches cancer patients with specially trained volunteer drivers. This program offers patients an additional key benefit of companionship and moral support during the drive to medical appointments.

The Society's transportation grants program allows hospitals and community organizations to apply for resources to administer their own transportation programs. In some areas, primarily where Road to Recovery programs are difficult to sustain, the Society provides transportation assistance to patients or their drivers via pre-paid gas cards to help defray costs associated with transportation to treatment.

Lodging during treatment: When someone diagnosed with cancer must travel far from home for the best treatment, where to stay and how to afford accommodations are immediate concerns and can sometimes affect treatment decisions. American Cancer Society Hope Lodge® facilities provide free, home-like, temporary lodging for patients and their caregivers close to treatment centers, thereby easing the emotional and financial burden of finding affordable lodging. In fiscal year 2009, the 29 American Cancer Society Hope Lodge locations provided more than 220,000 nights of free lodging to nearly 50,000 patients and caregivers, saving them more than $19 million in lodging expenses.

Breast cancer support: Breast cancer survivors provide one-on-one support, information, and inspiration to help people facing the disease cope with breast cancer through the Society's Reach to Recovery® program. Volunteer survivors are trained to respond in person or by telephone to people facing breast cancer diagnosis, treatment, recurrence, or recovery.

Prostate cancer support: Men facing prostate cancer can find one-on-one or group support through the Society's Man to Man® program. The program also offers men the opportunity to educate their communities about prostate cancer and to advocate with lawmakers for stronger research and treatment policies.

Cancer education classes: People with cancer and their caretakers need help coping with the challenges of living with the disease. Doctors, nurses, social workers, and other health care professionals provide them with that help by conducting the Society's I Can Cope® educational classes to guide patients and their families through their cancer journey.

Hair-loss and mastectomy products: Some women wear wigs, hats, breast forms, and bras to help cope with the effects of mastectomy and hair loss. The Society's *"tlc" Tender Loving Care®*, which is a magazine and catalog in one, offers helpful articles and a line of products to help women battling cancer restore their appearance and dignity at a difficult time. All proceeds from product sales go back into the American Cancer Society's programs and services for patients and survivors.

Support during treatment: When women are in active cancer treatment, they want to look their best, and Look Good...Feel Better® helps them do just that. The free program, which is a collaboration of the American Cancer Society, the Personal Care Products Council Foundation, and the National Cosmetology Association, helps women learn beauty techniques to restore their self-image and cope with appearance-related side effects of cancer treatment. Certified beauty professionals provide tips on makeup, skin care, nail care, and head coverings. Additional information and materials are available for men and teens.

Finding hope and inspiration: People with cancer and their loved ones do not have to face their cancer experience alone. They can connect with others who have "been there" through the Society's Cancer Survivors Network℠. The online community is a welcoming and safe place that was created by and for cancer survivors and their families.

Finding Cures

The goals of the American Cancer Society's research program are to determine the causes of cancer and to support efforts to prevent, detect, and cure the disease. The Society is the largest source of private, nonprofit cancer research funds in the US, second only to the federal government in total dollars spent. The Society spends an estimated $130 million on research each year and has invested approximately $3.4 billion in cancer research since the program began in 1946. The Society's comprehensive research program consisting of extramural grants, as well as intramural programs in epidemiology, surveillance and health policy research, behavioral research, and statistics and evaluation. Intramural research programs are led by the Society's own staff scientists.

Extramural Grants

The American Cancer Society's extramural grants program supports research in a wide range of cancer-related disciplines at about 230 US medical schools and universities.

Grant applications are solicited through a nationwide competition and are subjected to a rigorous external peer review, ensuring that only the most promising research is funded. The Society primarily funds investigators early in their research careers, a time when they are less likely to receive funding from the federal government, thus giving the best and the brightest a chance to explore cutting-edge ideas at a time when they might not find funding elsewhere. In addition to funding research across the continuum of cancer research, from basic science to clinical and quality-of-life research, the Society also focuses on needs that are unmet by other funding organizations, such as the current targeted research program to address the causes of the higher cancer mortality in the poor and medically underserved. To date, 44 Nobel Prize winners have received grant support from the Society early in their careers, a number unmatched in the nonprofit sector, and proof that the organization's approach to funding young researchers truly helps launch high-quality scientific careers.

Epidemiology and Surveillance Research

For more than 60 years, the Society's intramural epidemiology and surveillance research program has conducted and published high-quality epidemiologic research to advance understanding of the causes and prevention of cancer and monitored and disseminated surveillance information on cancer occurrence, risk factors, and screening. However, over time, the functions of the epidemiology and surveillance programs have grown and become more distinct. As a result, in 2009 the program formally split into two components: the Epidemiology program and the Surveillance and Health Policy Research program.

Epidemiology

As a leader in cancer research, the Society's Epidemiology Research program has been conducting studies to identify factors that cause or prevent cancer since 1951. The first of these, the Hammond-Horn Study, helped to establish cigarette smoking as a cause of death from lung cancer and coronary heart disease, and also demonstrated the Society's ability to conduct very large prospective cohort studies. The Cancer Prevention Study (CPS) I was launched in 1959 and included more than 1 million men and women recruited by 68,000 volunteers. Results from CPS-I clearly demonstrated that the sharp increase in lung cancer death rates among US women between 1959-1972 occurred only in smokers, and was the first to show a relationship between obesity and shortened overall survival.

In 1992, Cancer Prevention Study II (CPS-II) was established through the recruitment of 1.2 million men and women by 77,000 volunteers. The more than 480,000 lifelong nonsmokers in CPS-II provide the most stable estimates of lung cancer risk in the absence of active smoking. CPS-II data are used extensively by the Centers for Disease Control and Prevention (CDC) to estimate deaths attributable to smoking. The CPS-II study has also made important contributions in establishing the link between obesity and cancer. A subgroup of CPS-II participants, the CPS-II Nutrition Cohort has been particularly valuable for clarifying associations between cancer risk and obesity, physical activity, diet, use of aspirin, and hormone use. Blood samples from this group allow Society investigators and their collaborators at other institutions to study how genetic, hormonal, nutritional, and other factors measured in blood are related to the occurrence and/or progression of cancer.

The Cancer Prevention Studies have resulted in more than 400 scientific publications and have provided unique contributions both within the Society and the global scientific community. In addition to the key contributions to the effects of the tobacco epidemic over the past half-century, other important findings from these studies include:

- The association of obesity with increased death rates for at least 10 cancer sites, including colon and postmenopausal breast cancer
- The link between aspirin use and lower risk of colon cancer, opening the door to research on chronic inflammation and cancer
- The relationships between other potentially modifiable factors, such as physical inactivity, prolonged hormone use, and certain dietary factors, with cancer risk
- The association between air pollution, especially small particulates and ozone, with increased death rates from heart and lung conditions, which helped to motivate the Environmental Protection Agency to propose more stringent limits on air pollution

While landmark findings from the CPS-II Nutrition Cohort have informed multiple areas of public health policy and clinical practice, the cohort is aging. A new cohort is needed to explore the effects of changing exposures and provide greater opportunity to integrate biological measurements into studies of genetic and environmental risk factors. In 2006, Society epidemiologists began the enrollment of a new cohort, CPS-3, with the goal of recruiting and following approximately 500,000 men and women. All participants are providing blood samples at the time of enrollment. Following on the long history of partnering with Society volunteers and supporters for establishing a cohort, the Society's community-based Relay For Life® events are the primary venue for recruiting and enrolling participants. Although similar large cohorts are being established in some European and Asian countries, there are currently no studies of this magnitude in the US; therefore, the data collected from CPS-3 participants will provide unique opportunities for research in the US.

Surveillance and Health Policy Research

Through the Surveillance and Health Policy Research (SHPR) program, the Society publishes the most current statistics and trend information in *CA: A Cancer Journal for Clinicians* (caonline.amcancersoc.org), as well as a variety of *Cancer Facts & Figures* publications. These publications are the most widely cited sources for cancer statistics and are available in hard copy from Division offices and online through the Society's Web site at cancer.org/statistics. Society scientists also monitor trends in cancer risk factor and screening prevalence and publish these results annually – along with Society recommendations, policy initiatives, and evidence-based programs – in *Cancer Prevention & Early Detection Facts & Figures*. In addition, in 2007 the Surveillance Research department collaborated with the Department of International Affairs to publish the first edition of *Global Cancer Facts & Figures*, an international companion to *Cancer Facts & Figures*.

Since 1998, the Society has collaborated with the National Cancer Institute, the Centers for Disease Control and Prevention, the National Center for Health Statistics, and the North American Association of Central Cancer Registries to produce the Annual Report to the Nation on the Status of Cancer, a peer-reviewed journal article that reports current information related to cancer rates and trends in the US.

Epidemiologists in SHPR also conduct and publish high-quality epidemiologic research in order to advance understanding of cancer. Research topics include the causes of cancer, the population burden both in the US and abroad, and how differences in patient characteristics, such as health insurance status and comorbities, affect cancer outcomes. Recent studies have focused on the relationship between education and cancer mortality, temporal trends in breast cancer mortality by state, and trends in colorectal cancer internationally and by socioeconomic status and age in the US. The Health Policy Research program analyzes cancer treatment and outcomes and has focused on defining the role of health insurance in cancer disparities. Recent studies include examining the relationships between insurance status, race/ethnicity, stage at cancer diagnosis, quality of care, and cancer outcomes. The International Tobacco Control Research program conducts original research in international tobacco control with particular interest in the economics of tobacco control and collaborates to produce service publications such as *The Tobacco Atlas*.

Behavioral Research Center

The American Cancer Society was one of the first organizations to recognize the importance of behavioral and psychosocial factors in the prevention and control of cancer and to fund extramural research in this area. In 1995, the Society established the Behavioral Research Center (BRC) as an intramural department. The BRC's work focuses on five aspects of the cancer experience: prevention, detection and screening, treatment, survivorship, and end-of-life issues. It also focuses on special populations, including minorities, the poor, rural populations, and other underserved groups. The BRC's ongoing research projects include:

- Studies of the quality of life of cancer survivors. These studies include an ongoing, nationwide longitudinal study and a cross-sectional study, both of which explore the physical and psychosocial adjustment to cancer and identify factors affecting quality of life.
- Studies of family caregivers that explore the impact of the family's involvement in cancer care on the quality of life of the cancer survivor and the caregiver.
- Studies designed to reduce African American-white disparities in cancer-related behaviors among Georgians. One study investigates the role of sociocultural factors and neighborhood barriers in disparities in smoking, poor diet, lack of exercise, and cancer screening among a statewide sample of 7,200 African Americans. The other studies are community- and faith-based interventions to improve those cancer-related behaviors among African Americans.
- Studies being conducted in collaboration with other American Cancer Society departments with the goal of improving existing Society programs (e.g., FreshStart®, Quit For Life®) for smoking cessation, or develop new interventions for smokers who seek cessation assistance. Examples include a survey of smokers' preferences for cessation methods completed by smokers using the Society's Great Americans Web site, and testing of a system to provide tailored email messages to smokers timed around their quit date.
- Two randomized controlled studies funded by the National Institute of Drug Abuse that are examining the role of emotional support to smokers experiencing stress during a quit attempt.

Statistics and Evaluation Center

The Statistics & Evaluation Center (SEC) was created in 2005 to be a core resource for the American Cancer Society National Home Office and the Divisions. The SEC's mission is to deliver valid, reliable, accurate, and timely information to stakeholders from programs, projects, and business units so that they can make reliable and high-quality decisions that are evidence-based and cost-effective, thereby honoring the Society's fiduciary responsibility to its donors. The SEC provides valuable methods that can be used to generate new revenue streams or optimize processes to increase current revenue streams. In its short history, the SEC has collaborated with nearly every Society department/group, including the American Cancer Society Cancer Action Network (ACS CAN) and a number of Society Divisions across the country. The work of the SEC includes:

- Building rigorous study designs to produce valid and robust results for research or business
- Conducting all facets of program evaluation
- Creating and implementing survey instruments
- Collecting, archiving, managing, and statistically analyzing data and reporting results
- Conducting predictive statistical modeling to discover and understand patterns of cancer incidence, prevalence, morbidity, mortality, and cost
- Cancer clinical trials design

Fight Back

Conquering cancer is as much a matter of public policy as scientific discovery. Whether it's advocating for quality, affordable health care for all Americans, increasing funding for cancer research and programs, or enacting laws and policies that help decrease tobacco use, government action is constantly required. The American Cancer Society and its nonprofit, nonpartisan advocacy affiliate, the American Cancer Society Cancer Action Network (ACS CAN), use applied policy analysis, direct lobbying, grassroots action, and media outreach to ensure elected officials nationwide pass laws furthering the organizations' shared mission to create a world with less cancer. Created in 2001, ACS CAN is the force behind a new movement uniting and empowering cancer patients, survivors, caregivers, and their families. ACS CAN is a community-based grassroots movement that unites cancer survivors and caregivers, volunteers and staff, health care professionals, public health organizations, and other partners. ACS CAN gives ordinary people extraordinary power to fight back against cancer. In recent years, the Society and ACS CAN have successfully partnered to:

- Advocate for the patient voice to ensure that health care reform will provide affordable, adequate care for every American.
- Lead the fight to enact legislation that gives the US Food and Drug Administration the authority to regulate tobacco product manufacturing and marketing.
- Secure millions of dollars in new federal and state funding for cancer research, prevention, early detection, and education, and implement comprehensive state cancer control plans and fight efforts to cut funding.
- Help enact Michelle's Law, federal legislation that will ensure that insurance companies continue covering college students who take medical leave for up to 12 months.
- Advocate for expansion of the State Children's Health Insurance Program (SCHIP) to provide millions of uninsured children with critical health care coverage. (ACS CAN took the lead on proposing to pay for improving access to SCHIP with a cigarette tax increase that will help encourage millions of people to give up their deadly smoking habit.)
- Build support for new legislation to create a National Cancer Fund, which would serve as a dedicated funding source to meet broad cancer research prevention, early detection, and treatment needs in a comprehensive way.
- Pass and protect state and federal laws that guarantee insurance coverage of critical cancer screenings and treatments, including clinical trials.
- Help enact a new law that not only eliminated deductibles for the Welcome to Medicare benefit and expanded eligibility from six months to a year, but also empowered the US secretary of health and human services to approve new Medicare preventive services without need for congressional authorization.
- Lead the fight to reauthorize and seek full funding for the National Breast and Cervical Cancer Early Detection Program, which helps low-income, uninsured, and medically underserved women gain access to lifesaving breast and cervical cancer screenings and offers a gateway to treatment upon diagnosis.
- Pass state laws that will help all eligible Americans get screened and treated for colon cancer.
- Advocate for legislation to create a new nationwide colorectal screening and treatment program modeled after the National Breast and Cervical Cancer Early Detection Program.
- Increase the number of states and communities covered by comprehensive smoke-free workplace laws.

- Push for higher cigarette taxes and sufficient funding for tobacco prevention and cessation programs.
- Serve as the leading public health organization in the battle to increase the federal cigarette tax and use the revenue to expand the State Children's Health Insurance Program.
- Enact and seek full funding for the federal patient navigator program, which supports health care outreach in medically underserved communities for cancer patients and others suffering from chronic diseases.
- Eliminate statutory and regulatory barriers to effective management of pain and other side effects of cancer and its treatment at the state level, and seek passage of federal legislation that will improve pain care research, education, training, and access.
- Pursue expanded access to care through systemic change so that all Americans, regardless of income level or insurance status, have access to lifesaving prevention, early detection, and treatment opportunities.
- Create and launch the Judicial Advocacy Initiative (JAI), a program that will affect public policy through the legal system. With the help of pro bono representation, the JAI will monitor court cases and decisions that will impact the rights of cancer patients and survivors.
- Put federal and state lawmakers on the record in support of legislative action that helps the cancer community by having them sign the ACS CAN Congressional Cancer Promise and the American Cancer Society State Cancer Promise, respectively.
- Support legislation that allows volunteers to be reimbursed for the transportation expenses they incur helping cancer patients get to the doctor.

Some efforts in the fight against cancer are more visible than others, but each successful battle is an important contribution to what will ultimately be victory over the disease. The Society, working together with ACS CAN and its grassroots movement, is making sure the voice of the cancer community is heard in the halls of government and is empowering communities everywhere to fight back.

Sources of Statistics

New cancer cases. The estimated numbers of new US cancer cases are projected using a spatio-temporal model based on incidence data from 44 states and the District of Columbia for the years 1995-2006 that met the North American Association of Central Cancer Registries' (NAACCR) high-quality data standard for incidence, which covers about 89% of the US population. This method considers geographic variations in socio-demographic and lifestyle factors, medical settings, and cancer screening behaviors as predictors of incidence, as well as accounting for expected delays in case reporting. (See "B" in Additional Information on page 60 for more detailed information.)

Incidence rates. Incidence rates are defined as the number of people per 100,000 who are diagnosed with cancer during a given time period. State incidence rates presented in this publication are published in NAACCR's publication *Cancer Incidence in North America, 2002-2006*. Trends in cancer incidence rates and incidence rates by race/ethnicity were originally published in the 2009 Annual Report to the Nation on the Status of Cancer. (See "D" in Additional Information on page 60 for full reference.) Unless otherwise indicated, incidence rates in this publication are age adjusted to the 2000 US standard population to allow comparisons across populations with different age distributions. Incidence trends described in this publication are based on delay-adjusted incidence rates. Incidence rates that are not adjusted for delays in reporting may underestimate the number of cancer cases in the most recent time period. Cancer rates most affected by reporting delays are melanoma of the skin, leukemia, and prostate because these cancers are frequently diagnosed in non-hospital settings.

Cancer deaths. The estimated numbers of US cancer deaths are calculated by fitting the numbers of cancer deaths for 1969-2007 to a statistical model that forecasts the numbers of deaths expected to occur in 2010. The estimated numbers of cancer deaths for each state are calculated similarly, using state-level data. For both US and state estimates, data on the numbers of deaths are obtained from the National Center for Health Statistics (NCHS) at the Centers for Disease Control and Prevention.

Mortality rates. Mortality rates or death rates are defined as the number of people per 100,000 dying of a disease during a given year. In this publication, mortality rates are based on counts of cancer deaths compiled by NCHS for 1930-2006 and population data from the US Census Bureau. Unless otherwise indicated, death rates in this publication are age adjusted to the 2000 US standard population to allow comparisons across populations with different age distributions. These rates should be

compared only to other statistics that are age adjusted to the US 2000 standard population. The trends in cancer mortality rates reported in this publication were first published in the 2009 Annual Report to the Nation on the Status of Cancer. (See "D" in Additional Information for full reference.)

Important note about estimated cancer cases and deaths for the current year. The estimated numbers of new cancer cases and deaths in the current year are model-based and may produce numbers that vary considerably from year to year. For this reason, the use of our estimates to track year-to-year changes in cancer occurrence or deaths is strongly discouraged. Incidence and mortality rates reported by the Surveillance, Epidemiology, and End Results (SEER) program and NCHS are more informative statistics to use when tracking cancer incidence and mortality trends for the US. Rates from state cancer registries are useful for tracking local trends.

Survival. Unless otherwise specified, 5-year relative survival rates are presented in this report for cancer patients diagnosed between 1999 and 2005, followed through 2006.

Relative survival rates are used to adjust for normal life expectancy (and events such as death from heart disease, accidents, and diseases of old age). Relative survival is calculated by dividing the percentage of observed 5-year survival for cancer patients by the 5-year survival expected for people in the general population who are similar to the patient group with respect to age, sex, race, and calendar year of observation. Five-year survival statistics presented in this publication were originally published in *CSR 1975-2006*. In addition to 5-year survival rates, 1-year, 10-year, and 15-year survival rates are presented for selected cancer sites. These survival statistics are generated using the National Cancer Institute's SEER 17 database and SEER*Stat software version 6.5.2. (See "G" in Additional Information.) One-year survival rates are based on cancer patients diagnosed between 2002 and 2005, 10-year survival rates are based on diagnoses between 1993 and 2005, and 15-year survival rates are based on diagnoses between 1988 and 2005. All patients were followed through 2006.

Probability of developing cancer. Probabilities of developing cancer are calculated using DevCan (Probability of Developing Cancer) software version 6.4.0, developed by the National Cancer Institute. (See "H" in Additional Information.) These probabilities reflect the average experience of people in the US and do not take into account individual behaviors and risk factors. For example, the estimate of 1 man in 13 developing lung cancer in a lifetime underestimates the risk for smokers and overestimates risk for nonsmokers.

Additional information. More information on the methods used to generate the statistics for this report can be found in the following publications:

A. For information on data collection methods used by the North American Association of Central Cancer Registries: Copeland G, Lake A, Firth R, et al. (eds). *Cancer in North America, 2002-2006. Volume One: Combined Cancer Incidence for the United States and Canada.* Springfield, IL: North American Association of Central Cancer Registries, Inc. June 2009. Available at naaccr.org/filesystem/pdf/CINA2009.v1.combined-incidence.pdf.

B. For information on the methods used to estimate the numbers of new cancer cases: Pickle L, Hao Y, Jemal A, et al. *CA Cancer J Clin.* 2007; 57:30-42.

C. For information on data collection methods used by the SEER program: Horner MJ, Ries LAG, Krapcho M, et al. (eds). *SEER Cancer Statistics Review, 1975-2006.* National Cancer Institute. Bethesda, MD, 2009. Available at: seer.cancer.gov/csr/1975_2006/.

D. For information on cancer incidence trends reported herein: Edwards BK, Ward EM, Kohler BA, et al. *Cancer.* 2010; 116:544-573.

E. For information on data collection and processing methods used by NCHS: cdc.gov/nchs/deaths.htm. Accessed December 9, 2009.

F. For information on the methods used to estimate the number of cancer deaths: Tiwari, et al. *CA Cancer J Clin.* 2004; 54:30-40.

G. For information on the methods used to calculate relative survival rates: software – Surveillance Research Program, National Cancer Institute SEER*Stat software (seer.cancer.gov/seerstat) version 6.5.2; database – Surveillance, Epidemiology, and End Results (SEER) Program (seer.cancer.gov) SEER*Stat Database: Incidence – SEER 17 Regs Limited-Use, Nov 2008 Sub (1973-2006 varying) – Linked to County Attributes – Total US, 1969-2006 Counties, National Cancer Institute, DCCPS, Surveillance Research Program, Cancer Statistics Branch, released April 2009, based on the November 2008 submission.

H. For information on the methods used to calculate the probability of developing cancer: DevCan 6.4.0. Probability of developing or dying of cancer. Statistical Research and Applications Branch, NCI, 2009. Available at: srab.cancer.gov/devcan/.

Factors That Influence Cancer Rates

Age Adjustment to the Year 2000 Standard

Epidemiologists use a statistical method called "age adjustment" to compare groups of people with different age compositions. This is especially important when examining cancer rates, since cancer is generally a disease of older people. For example, without adjusting for age, it would be inaccurate to compare the cancer rates of Florida, which has a large elderly population, to that of Alaska, which has a younger population. Without adjusting for age, it would appear that the cancer rates in Florida are much higher than Alaska. However, once the ages are adjusted, it appears their rates are similar.

Since the publication of *Cancer Facts & Figures 2003*, the American Cancer Society has used the Year 2000 Standard for age adjustment. This is a change from statistics previously published by the Society. Prior to 2003, most age-adjusted rates were standardized to the 1970 census, although some were based on the 1980 census or even the 1940 census. This change has also been adopted by federal agencies that publish statistics. The new age standard applies to data from calendar year 1999 forward. The change also requires a recalculation of age-adjusted rates for previous years to allow valid comparisons between current and past years.

The purpose of shifting to the Year 2000 Standard is to more accurately reflect contemporary incidence and mortality rates, given the aging of the US population. On average, Americans are living longer because of the decline in infectious and cardiovascular diseases. Greater longevity allows more people to reach the age when cancer and other chronic diseases become more common. Using the Year 2000 Standard in age adjustment instead of the 1970 or 1940 standards allows age-adjusted rates to be closer to the actual, unadjusted rate in the population.

The effect of changing to the Year 2000 Standard will vary from cancer to cancer, depending on the age at which a particular cancer usually occurs. For all cancers combined, the average annual age-adjusted incidence rate for 2000-2004 will increase approximately 20% when adjusted to the Year 2000, compared to the Year 1970 Standard. For cancers that occur mostly at older ages, such as colon cancer, the Year 2000 Standard will increase incidence by up to 25%, whereas for cancers such as acute lymphocytic leukemia, the new standard will decrease the incidence by about 7%. These changes are caused by the increased representation of older ages (for all cancers combined and colon cancer) or by the decreased representation of younger ages (for acute lymphocytic leukemia) in the Year 2000 Standard, compared to the Year 1970 Standard.

It is important to note that in no case will the actual number of cases/deaths or age-specific rates change, only the age-standardized rates that are weighted to the different age distribution.

Change in Population Estimates

Cancer rates are also affected by changes in population estimates, which are the basis for calculating rates for new cancer cases and deaths. The US Census Bureau updates and revises population estimates every year. The Bureau calculates "intercensal" estimates after a new census is completed – for example, using information from both the 1990 and 2000 censuses, the Bureau obtains better estimates for the 1990s. These revisions are based on the most recent census information and on the best available demographic data reflecting components of population change (e.g., births, deaths, net internal migration, and net international immigration). Thus, it is customary to recalculate cancer rates based on the revised population estimates. In less populated areas, such as rural counties, or in adjacent urban and suburban areas where there is substantial migration of residents from a more populous urban area to a less populous suburban one between censuses, a change in the population estimates can affect the county rate by as much as 20%. This is in contrast to large counties, where a small change in a large population estimate will not affect rates nearly as much. More information about the influence of change in population count on US cancer rates is available on the National Cancer Institute Web site (cancer.gov/newscenter/pressreleases/Census2000).

Screening Guidelines for the Early Detection of Cancer in Average-risk Asymptomatic People

Cancer Site	Population	Test or Procedure	Frequency
Breast	Women, age 20+	Breast self-examination	Beginning in their early 20s, women should be told about the benefits and limitations of breast self-examination (BSE). The importance of prompt reporting of any new breast symptoms to a health professional should be emphasized. Women who choose to do BSE should receive instruction and have their technique reviewed on the occasion of a periodic health examination. It is acceptable for women to choose not to do BSE or to do BSE irregularly.
		Clinical breast examination	For women in their 20s and 30s, it is recommended that clinical breast examination (CBE) be part of a periodic health examination, preferably at least every three years. Asymptomatic women aged 40 and over should continue to receive a clinical breast examination as part of a periodic health examination, preferably annually.
		Mammography	Begin annual mammography at age 40.*
Colorectal†	Men and women, age 50+	*Tests that find polyps and cancer:* Flexible sigmoidoscopy,‡ or	Every five years, starting at age 50
		Colonoscopy, or	Every 10 years, starting at age 50
		Double-contrast barium enema (DCBE),‡ or	Every five years, starting at age 50
		CT colonography (virtual colonoscopy)‡	Every five years, starting at age 50
		Tests that mainly find cancer: Fecal occult blood test (FOBT) with at least 50% test sensitivity for cancer, or fecal immunochemical test (FIT) with at least 50% test sensitivity for cancer‡,§ or	Annual, starting at age 50
		Stool DNA test (sDNA)‡	Interval uncertain, starting at age 50
Prostate	Men, age 50+	Prostate-specific antigen test (PSA) with or without digital rectal exam (DRE)	Asymptomatic men who have at least a 10-year life expectancy should have an opportunity to make an informed decision with their health care provider about screening for prostate cancer after receiving information about the uncertainties, risks, and potential benefits associated with screening. Men at average risk should receive this information beginning at age 50. Men at higher risk, including African American men and men with a first degree relative (father or brother) diagnosed with prostate cancer before age 65, should receive this information beginning at age 45. Men at appreciably higher risk (multiple family members diagnosed with prostate cancer before age 65) should receive this information beginning at age 40.
Cervix	Women, age 18+	Pap test	Cervical cancer screening should begin approximately three years after a woman begins having vaginal intercourse, but no later than 21 years of age. Screening should be done every year with conventional Pap tests or every two years using liquid-based Pap tests. At or after age 30, women who have had three normal test results in a row may get screened every two to three years with cervical cytology (either conventional or liquid-based Pap test) alone, or every three years with an HPV DNA test plus cervical cytology. Women 70 years of age and older who have had three or more normal Pap tests and no abnormal Pap tests in the past 10 years and women who have had a total hysterectomy may choose to stop cervical cancer screening.
Endometrial	Women, at menopause	At the time of menopause, women at average risk should be informed about risks and symptoms of endometrial cancer and strongly encouraged to report any unexpected bleeding or spotting to their physicians.	
Cancer-related checkup	Men and women, age 20+	On the occasion of a periodic health examination, the cancer-related checkup should include examination for cancers of the thyroid, testicles, ovaries, lymph nodes, oral cavity, and skin, as well as health counseling about tobacco, sun exposure, diet and nutrition, risk factors, sexual practices, and environmental and occupational exposures.	

* Beginning at age 40, annual clinical breast examination should be performed prior to mammography.

†Individuals with a personal or family history of colorectal cancer or adenomas, inflammatory bowel disease, or high-risk genetic syndromes should continue to follow the most recent recommendations for individuals at increased or high risk.

‡ Colonoscopy should be done if test results are positive.

§ For FOBT or FIT used as a screening test, the take-home multiple sample method should be used. A FOBT or FIT done during a digital rectal exam in the doctor's office is not adequate for screening.

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Exhibit 2

Greenwich Hospital
Historical Volume by Town
Fiscal Year 2009

Town	State	Fiscal Year 2009
Service Area Towns		
GREEENWICH	CT	336
STAMFORD	CT	84
PORT CHESTER	NY	48
DARIEN	CT	27
MAMARONECK	NY	25
RYE	NY	25
NEW CANAAN	CT	18
NORWALK	CT	17
POUND RIDGE	NY	12
WHITE PLAINS	NY	11
WESTPORT	CT	10
LARCHMONT	NY	10
NEW ROCHELLE	NY	9
WILTON	CT	6
SCARSDALE	NY	6
WESTON	CT	5
BEDFORD	NY	5
HARRISON	NY	5
MT VERNON	NY	1
Other Connecticut		19
Other New York		31
Other States		17
TOTAL		727

Source: GH Information Systems

Note: Includes only those towns that had volume during FY09

Exhibit 3

The British Journal of Radiology, 75 (2002), 937–949

Review article

CT simulation for radiotherapy treatment planning

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Abstract. The present status of CT simulation (CT sim) hardware, software and practice is reviewed, particularly with regard to the changes that have taken place over the last 5 years. The latest technology is discussed together with some recently developed techniques. The article concludes with a discussion of virtual simulation *vs* physical (conventional) simulation; in particular there is a review of the changes that have been made to the "Disadvantages table" presented by Conway and Robinson [1], which now make CT sim an attractive system for any radiotherapy department.

The demands of modern radiotherapy planning are quite different from those 20 years ago. Clinicians now require to define the target volume more precisely, not just in two dimensions, but also in three dimensions. It has therefore become necessary to visualize anatomy in three dimensions to enable planning to conform the dose around the target volume in order to irradiate the tumour to as high a dose as possible, whilst saving the normal tissues. In order to achieve this the following tools are necessary:

- Identification of critical structures using advanced anatomical and functional imaging methods.
- Visualization of treatment targets with respect to other structures in three dimensions.
- Efficient and accurate outlining of tumour using contouring tools.
- Addition of symmetrical or asymmetrical volumetric margins.
- Beam's eye view (BEV) of targets and structures.
- Shaping fields around the target.
- Adding beams together.
- Dose volume histogram (DVH) generation.
- Tools for optimizing plans using forward or inverse interactive techniques.
- Export of plan to linear accelerator.
- Monitor unit calculations.
- Export of digitally reconstructed radiographs, (DDRs — see below) to an image database for on-line assessment of treatment accuracy.

Some identification of tumour will be achieved with modalities other than CT, such as MRI and positron emission tomography. These complementary modalities and their uses will not be considered here. However, it is important for the reader to be aware of the potentials and pitfalls of these imaging techniques in oncology and that, generally, they are co-registered to CT in order to maintain geometric accuracy on the computer three-dimensional (3D) image of the patient.

It is the intention of this article to review the place of CT simulation (CT sim) in radiotherapy planning as it has developed since the article by Conway and Robinson in 1997 [1].

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CT planning development

When CT became available to radiotherapy patients in the 1970s, its role in treatment planning was very quickly recognized [2] since the transverse cross-sections produced are exactly the sections required for isodose charting. However, it has taken many years of development to realise the full impact that CT can have in treatment planning, since it has been necessary to wait for rapid scanning and very rapid computing power to implement the most important aspects of CT planning and develop these into CT sim.

The transfer of planning information (reference marks, field entry point etc.) from CT sim to the patient prior to treatment is the most critical step; without an accurate and reliable method of doing this, the usefulness of CT planning is greatly reduced and, indeed, may introduce error. The practice of virtual simulation (VSIM) relies on this concept being realisable. The two main elements of VSIM essential to its accuracy and verification of an individual patient's treatment are: transfer of coordinates (marks identifying

beam centres, field edges, block positions etc. as necessary); and the construction of DDRs [3].

Goitein and Abrams [4] and Goitein et al [5] discussed the development of CT planning from a system performing "almost none of the functions associated with a treatment simulator" to a system where "the simulation of treatment by the computer can be much more comprehensive and valuable". Goitein et al [5] developed the concept of beam's eye view (BEV) following the idea of McShan et al [6], and recognized the importance of projecting through CT sections to produce an image for verification purposes. It was, however, Sherouse et al [7] and Sherouse and Chaney [8] who first used the terms virtual simulation and virtual simulator, and the concept of the DRR was further developed by Sherouse et al [9]. The DRR "traces rays from the X-ray source through a 3-dimensional model of the patient made up of voxels determined from CT scans" [9]. This particular DRR software also separated photoelectron and Compton components in order to compute either a DRR similar to a verification image on the simulator or a DRR that looked more like the high-energy portal radiograph taken on the linear accelerator. These different images are produced using different image processing techniques in the modern virtual simulator.

Processing the DRR, particularly the use of various types of filter to change the appearance of the image, is now considered to be a major asset of VSIM. More information can be visualized than in conventional radiography, even if some detail is lost in the digital nature of the image with its finite number of pixels (typically 512×512). Standard filters include low energy, to simulate a 60–80 kV radiograph (simulator film filter), high energy, to simulate 6 MV portal image (port film filter), customizable filters (window/level mapping) and special techniques, *e.g.* depth control/depth shading. Depth control or depth shading is the reconstruction of a DRR for a limited range of depths (a region of interest defined by the user) in which, say, the target lies. This produces an image that is very useful for checking margins. It is superior to a conventional radiograph, particularly if bone overlies the region of interest.

A key feature to the efficient use of CT sim is the speed of reconstruction of DRR. This used to take a minute or more, however, it is now possible to move a beam and have the new DRR recalculated and displayed almost in real time.

Another feature of CT planning and VSIM recognized by early workers in this field was the use of non-coplanar beams [10]. These beams were already in use to treat patients, but verification using imaging could not generally be achieved. The size of the image intensifier on the simulator often prevented positioning of the beam with the correct geometry with respect to the target and the patient. The image was also difficult to interpret. Both of these problems could be overcome in VSIM. In particular, interpretation of the image became possible since not only could it be processed to improve the quality of the image, but by looking at the set of transverse sections, it was possible to see the various organs and structures covered by the beam.

Specification of a CT simulator (Figure 1)

The term CT sim is associated with "virtual simulation", a term coined by Sherouse et al [7] to

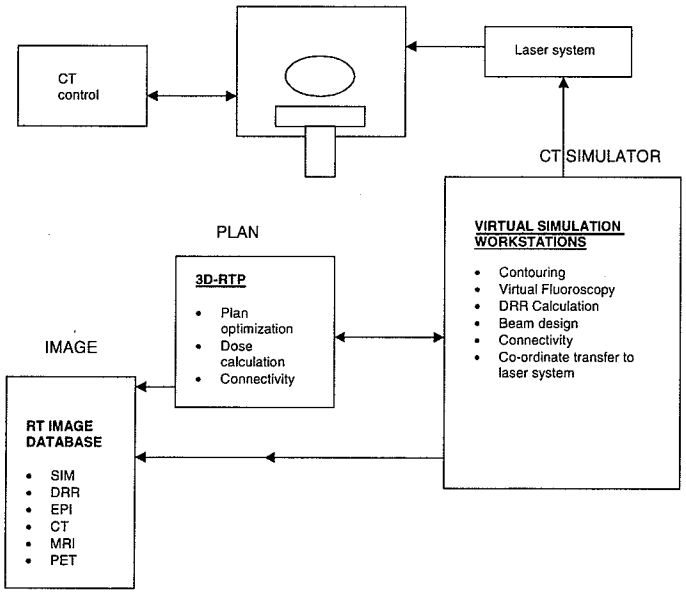

Figure 1. Schematic of CT simulator and associated systems. DRR, digitally reconstructed radiograph; EPI, electronic portal imaging; PET, positron emmission tomography; RTP, radiotherapy treatment planning.

refer to the processes on a computer, using a 3D CT patient data set, that allow full simulation and verification of radiotherapy treatment. CT Sim= physical CT scanning (patient required)+VSIM (patient not required). The main item of equipment needed is a CT scanner connected to a computer containing a suite of programmes that allow all the processes outlined above to be performed, including virtual modelling of the radiotherapy simulator process together with advanced DRR production (many of these features of VSIM are now built into the treatment planning system), with the addition of moveable lasers driven under computer control.

Specification of a typical CT scanner

Table 1 shows the main features of a typical CT scanner. The dedicated Philips AcQsim CT scanner (Philips Medical Systems Ltd, Stevenage, UK) (Figure 2), has some features that differ slightly from those in Table 1. In particular, since it is a fourth generation scanner, it has a complete ring of 2400 detectors, aperture is 85 cm and minimum slice width is 2 mm.

One of the other features installed by several workers [11, 12] is a laser on the same rotating arm as the X-ray set, with the potential for marking not just the centres of beams from any direction, but also the field edges of irregular fields. This laser feature is an important addition, but does not need to be built into the CT scanner as in some of the early CT sims. This feature is now normally installed as a set of orthogonal lasers mounted on the walls and ceiling of the room, or on a special rigid gantry. The ceiling laser (sagittal line) must be able to move laterally under computer control to allow the isocentre for a particular plan to be marked; on some systems it is also possible to move the other lasers to define the isocentre completely, instead of relying on longitudinal and vertical movement of the CT couch.

Table 1. Main features of a typical CT scanner

Feature	Specification
Aperture	At least 70 cm (see below)
Number of detectors	672–896 per row
X-ray tube	80–130 kV; 250 to 500 mA depending on kV (typically 50–60 kW)
Heat capacity	6–7 MHU
Anode heat cooling	700–900 kHU min^{-1}
Minimum slice width	1 mm
Patient support	Table top identical to that used on treatment machine
Spatial resolution	High Contrast: better than 13 line pairs cm^{-1} (at 0% MTF)
	Low contrast: 5 mm at 3% resolution
Acquisition time	1–2 slice/rev s^{-1} (multislice 4 or 8 slice/rev s^{-1})
	Covering a width of 20–32 mm at isocentre
Reconstruction time	Few seconds up to 60 s total time to end of 30 mm slice
Virtual simulation	
DRR calculation	Few seconds (tolerable), sub-second (desirable)
Capacity to store	12 000–60 000 uncompressed images on hard disc
Laser accuracy	±1 mm
Accuracy of slice location	<1 mm

DRR, digitally reconstructed radiograph; MHU, mega heat units; MTF, modulation transfer function.

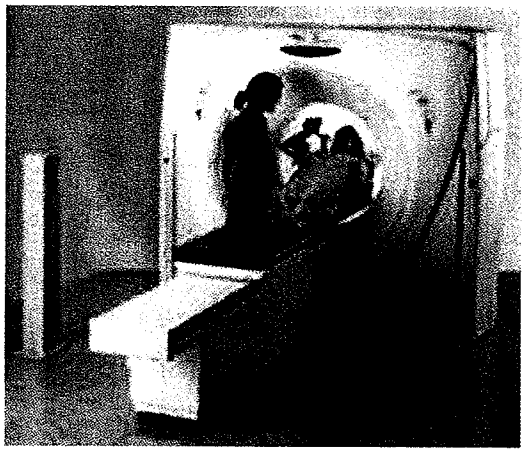

Figure 2. Large bore (85 cm physical aperture) oncology CT scanner showing breast patient positioning (photo reproduced by permission of Phillips Medical Systems).

Virtual simulator software

The most important features of the virtual simulator are fast CT scanning and reconstruction of transverse slices, fast reconstruction of any section, automatic skin outlining, automatic lung/bone outlining, semi-automatic outlining of critical structures/vital organs, user friendly target outlining (accurate interpolation/ease of editing) and volumetric growing of margins using a true 3D volume growing algorithm.

It should not be necessary to outline all features on all slices; interpolation is possible provided that the user does not leave too many gaps for the computer to fill in. Outlining the tumour volume, usually the gross tumour volume (GTV), is the clinician's responsibility. Again, some degree of interpolation is possible provided that the contours on the interpolated slices are checked for accuracy. Methods of linear and non-linear contour interpolation are combined with manual slice-by-slice checking and editing. The treatment planner then grows the GTV to the planning

target volume (PTV) by a true 3D volume growing algorithm [13]; many planning systems now allow for different margins to be added in different directions.

3D display systems are continually improving. These are vital features to any virtual simulator since internal anatomy, beam geometry and dose distributions need to be easily and accurately displayed and manipulated quickly. It is especially important that the PTV is seen by the planner in three dimensions to be covered by the high dose region and, conversely, that critical structures and vital organs are in low dose regions. Of course, other tools within the planning system, *e.g.* dose–volume histograms (DVHs), assist this process, but generally these do not contain the geometrical and anatomical information given in the image display. Several commercial systems offer additional features within their VSIM package, such as a virtual light field, which illuminates the skin surface of the 3D image of the patient. Most systems also have an image of the treatment machine together with a picture of the patient on the treatment table. The gantry and table will move to show the position of the beam chosen and particularly whether there is any possibility of a collision.

Other aspects of CT sim

Multislice CT scanners

As multislice CT scanners become more common in diagnostic radiology it will be important for the radiotherapy community to assess their role for VSIM. One issue is that of speed. An 8-slice scanner can scan 48 cm in 3–6 s at 1 cm slice width, or 48 cm in 15–30 s at 2 mm slice width. With older systems these times would nominally be approximately eight times longer (the latter time, at least 240 s, would require pauses for anode cooling, or would not be attempted).

Fast scan times are advantageous in reducing motion artefacts, but there will be a question as to which phase of breathing has been scanned. With the older single slice systems there is some blurring of images owing to patient movement. This has been accepted since the patient is treated with beam-on times similar to CT scanning times, and it has been assumed that any effects of movement would be averaged out. However, now that more centres are beginning to address the problem of motion, both on the CT scanner and on treatment, the faster scanners may be an enormous advantage.

Multislice scanners will also need to be assessed for their accuracy since the off-axis slices need to be reconstructed from ray paths travelling obliquely through the patient.

Dedicated CT?

The special requirements of a CT simulator suggest that a dedicated CT scanner designed to fit the demands of radiotherapy planning on CT is required. However, many centres will also wish to use their CT simulator for diagnostic work. As diagnostic scanners are developed for purposes other than radiotherapy, we may see a divergence in development between the two types of equipment. Each centre will need to specify its own requirements, provided that the computer network connections can be made so that any CT scanner can be linked to a computer with its virtual simulator package (see below), with the need also to add a laser marking-up system.

Immobilization

The importance of effective positioning of the patient to facilitate optimum treatment design and the ability to re-establish this position on a daily basis are recognized as essential to accurate radiotherapy. Some of the early work [9] with CT sim emphasized the difficulties of emulating the patient support and accessory attachments of a linear accelerator on a CT scanner. After 10 years of CT sim use, manufacturers have recognized the need to provide a table top that is identical to the top used on the treatment machine (previously it was standard practice to provide a flat-top couch insert to the conventional curved CT diagnostic couch that could easily rotate slightly so that the patient was no longer on a horizontal surface). The CT therapy couch top should also be designed to take the usual accessories needed to position the patient, for example breast boards and head rests. These accessories significantly enhance positioning accuracy and patient comfort and reduce patient set-up time.

Aperture

The constraints of a 70 cm aperture on radiotherapy patient positioning are obvious for some treatments, such as breast and mantle techniques. The move to more dedicated oncology CT scanners has led to designs that can accommodate these set ups using a larger aperture. One commercial system is available, the Marconi AcQsim CT Scanner (Philips Medical Systems Ltd, Stevenage, UK), with an aperture of 85 cm (Figure 2). At the present time, potential purchasers wishing to decide which system to choose will need to explore the compromise that has to be made between aperture size and image quality and the possible need to modify set-up techniques.

Display

A modern virtual simulator system will have many options to display all the required features in colour/colour wash/line drawing, or to remove features as required. It is usually possible to view all sections, namely axial, coronal or sagittal, in multiple windows on the same computer page. Other features will include 3D views with appropriate CT slices superimposed and rotation of the 3D view.

CT sim to radiotherapy treatment planning system connectivity

The importance of efficient and accurate connectivity between CT sim and radiotherapy treatment planning system (RTPS) radiotherapy treatment planning systen cannot be overemphasized. Many of the problems associated with having two separate computer systems, one providing the function of a simulator and the other providing a dose calculation engine, are due to theincompatibilities between common parameter transfer protocols. Standards such as Digital Imaging and Communications in Medicine DICOMv3, and the standard image transfer protocol for radiotherapy (DICOM-RT) can be highly complex to implement and can vary in interpretation. The advent of DICOM-RT enables export of radiotherapy images, treatment plans and structure sets (contours). However, this standard is not always fully implemented and can have exclusions, *e.g.* dynamic treatment data, that can limit functionality. Problems may be encountered when transferring data, even between systems from the same manufacturer. Transfer protocols should be fully tested for all conditions and any inconsistencies reported.

Most CT sim systems are configured as single virtual simulator workstations interfaced to a CT scanner. Problems arise when additional VSIM stations are added to accommodate increased workload, with multiple copies of patient data and lack of synchronization between these files. Future systems must incorporate patient images, structures and treatment files in a database that enables multi-user access with full data protection, *e.g.* file locked while in use to avoid secondary access.

Treatment charting (dosimetry)

Modern VSIM software packages also contain many of the features of a treatment planning system, with the exception of the calculation of dose distribution. Correspondingly, modern treatment planning systems are now available with VSIM software. For VSIM or treatment planning systems the typical features for conventional and conformal planning include:

- beam position/rapid editing of position, size, wedge, weight;
- adding further beams using copy/position facilities;
- auto-beam positions according to a stored protocol (beam configuration library);
- auto-shaping for the multileaf collimator/blocks including optimization of collimator angle;
- accurate 3D calculation of dose from each beam using a complex dose calculation algorithm, taking 3D scatter and inhomogeneities into account;
- display of complete dose distribution; and
- calculation of monitor units for each beam.

CT sim/VSIM process

General

This process may vary depending on local procedures adopted to suit the working conditions of a particular department. The ultimate aim is to achieve the same level of treatment simulation as conventional physical methods but with the added features that are available from 3D visualization. Significant advantage is gained through the reduced visits required by the patient and the flexibility offered through tasks, such as contour marking, that can be undertaken after the patient has left.

A general discussion of the CT VSIM process follows, with an indication of alternative methods and options where appropriate.

The patient is positioned on the flat-top couch of a CT scanner in the treatment position. Alignment of the patient is made with lateral wall lasers and sagittal laser. Opaque catheters may be used as visual markers. A prior simulator visit is not usually required. A pilot (scout view) scan is made to determine the region over which axial slices will be scanned. These slices are then made according to the particular protocol for the site to be treated, *e.g.* prostate. A single visit to the CT simulator is usually preferred. Two methods can be adopted. The first requires the oncologist to be present to identify the target volume and isocentre from the scan information while the patient remains in the treatment position. In the second method the operator identifies a reference slice containing a reference point from the scan study and target definition is then undertaken when the oncologist is available. In both methods the patient is "marked" where the laser projection illuminates the skin and finally the patient is removed from the couch. In the second method

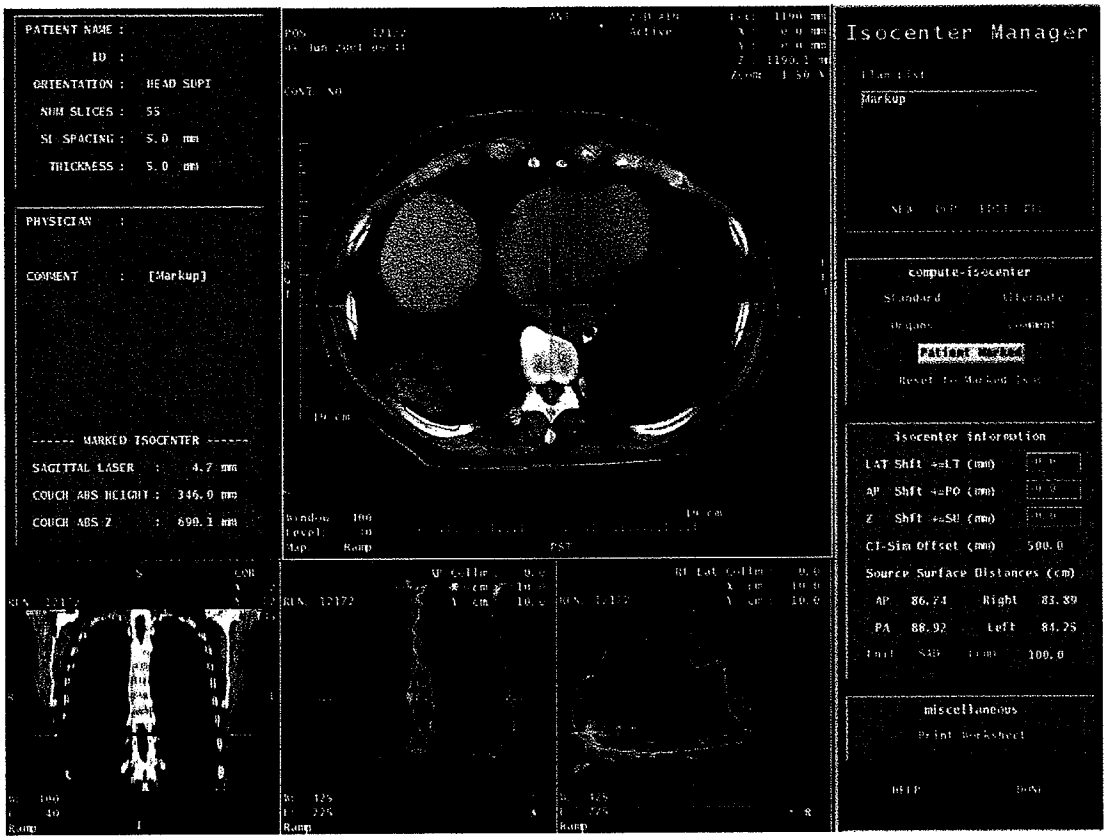

Figure 3. Localization: a suitable "patient origin" (isocentre) is marked as the centre of the purple triangle (mark-up). These coordinates are sent to the laser system and the patient marked. All plan isocentres are related to this mark in terms of "shift coordinates".

the isocentre is eventually defined in terms of "shift coordinates from the reference point" (Figure 3).

The remaining parts of the VSIM process depend on whether beam calculation is required. Dose calculation will usually be undertaken by a system designed with a high quality beam model. The data from the virtual simulator must be accurately and seamlessly transferred to this system and eventually returned to the virtual simulator for verification. Some planning systems may be capable of producing high resolution DRRs that may negate this return process. Plans that do not require dose calculation, such as simple parallel pairs, can have their plan optimization and verification achieved by the virtual simulator. Many of these plan optimization tools are features of most planning systems. In the early stages of implementing CT VSIM, some centres may wish to continue with physical simulation until confident of the accuracy of the process. This will necessitate another patient session prior to treatment but may avoid problems when commencing treatment with the inevitable impact on machine throughput. DRRs can usually be calculated in real time (Figure 4) for all the beams that will be used at portal verification on the accelerator. In some cases, *e.g.* prostate, only anterior and lateral beam DRRs are necessary to allow effective reconciliation with film or electronic portal imaging device portal images.

In some situations the patient may have to return to the conventional simulator. Examples are where the staff at a centre are not sufficiently confident with CT VSIM; VSIM cannot demonstrate definitely that the fields that have been chosen can be given by the particular treatment machine; the DRRs are not sufficiently good compared with conventional simulator images; and problems with the patient's treatment cannot be resolved using virtual methods that would necessitate a repeat CT scan.

Examples of CT sim practice

The CT sim process depends on defining a relationship between the CT image coordinates (patient) and the treatment coordinates (machine) that allows a precise transformation from the localization setup to radiotherapy treatment

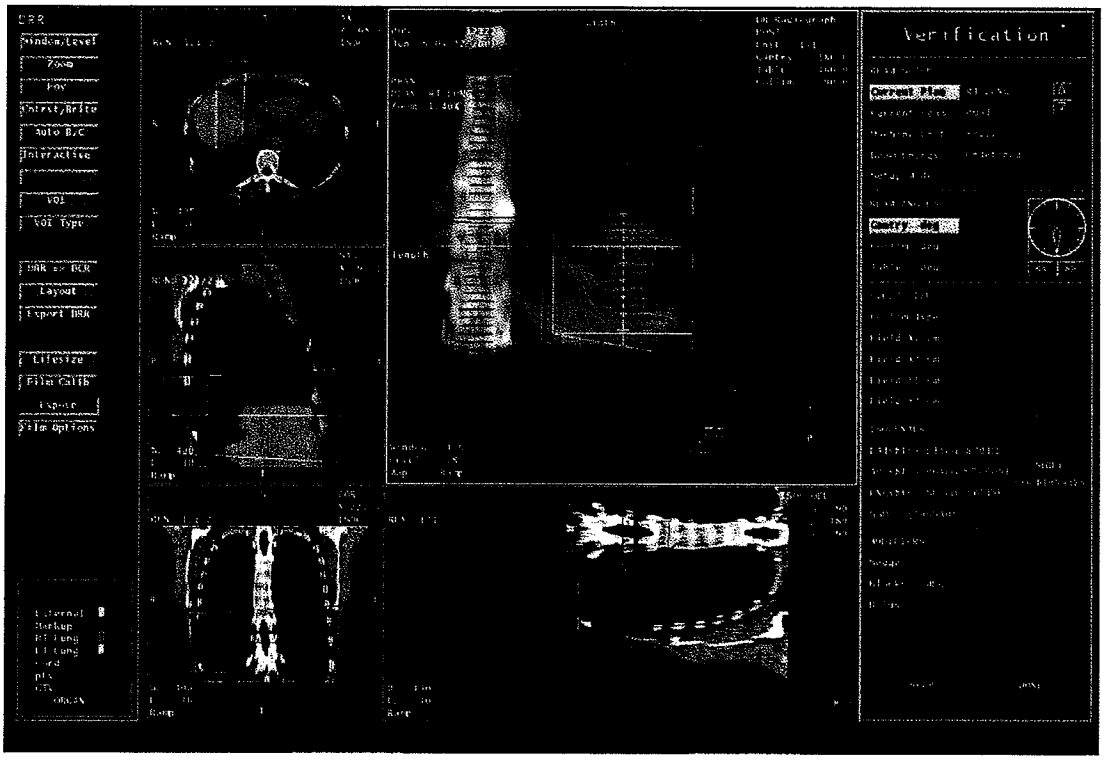

Figure 4. Verification: the "shift coordinates" represent the relationship between the isocentre and the "patient marked origin" to be used for treatment setup. All field digitally reconstructed radiographs are exported for portal verification on the linear accelerator.

coordinate space. The methods of achieving this are dependent on local equipment and working practices. Inherent in all successful CT sim techniques is the appropriate immobilization of the patient that is compatible with the constraints of the CT scanner. For some sites radiotherapy techniques will have to be adapted to accommodate these constraints.

Successful CT sim practice will require changes to working practice that will allow similar patient throughput to a conventional simulator. This may require flexible working of the oncologists involved in defining treatment volumes. The advantages of CT sim over conventional simulation, such as one planning session visit for the patient, volume mark-up without the patient present and minimal patient wait, can only be realised if working practice is tailored to the system.

The following is a discussion about some site-specific CT sim procedures.

Breast (Figure 5a)

Stage 1. Localization is usually undertaken with the patient positioned on a purpose designed "breast board". The patient's arms must not impede free movement of the CT couch and therefore careful thought must be given to the design of the board. Use of large aperture CT will allow more flexibility in patient positioning.

The scan protocol is typically a slice thickness of 5 mm with a spiral pitch of 1.5, which will give 50–60 slices in the study. Slice parameters set larger than this may result in poor DRRs. Movement of the chest during slice acquisition can also result in visible discontinuities in sagittal reconstruction.

Radio-opaque catheters can be used to mark superior, inferior, medial and lateral extents of the volume. The patient is scanned to include superior and inferior extents (from the pilot scan) and external contouring of those slices containing the catheters are performed (purple lines in Figure 5a).

A reference mark is set to the medial catheter on the central slice, midway between the superior and inferior marked slices, and this is defined as the "patient origin". The patient is marked using the patient origin coordinates transferred to the CT sim couch and lasers. The patient session is now finished.

Stage 2. VSIM planning requires the glancing fields to be positioned in BEV so that the posterior field edges pass through the medial and lateral catheters. Adjustments are made to minimize encompassed lung, this can be visualized by

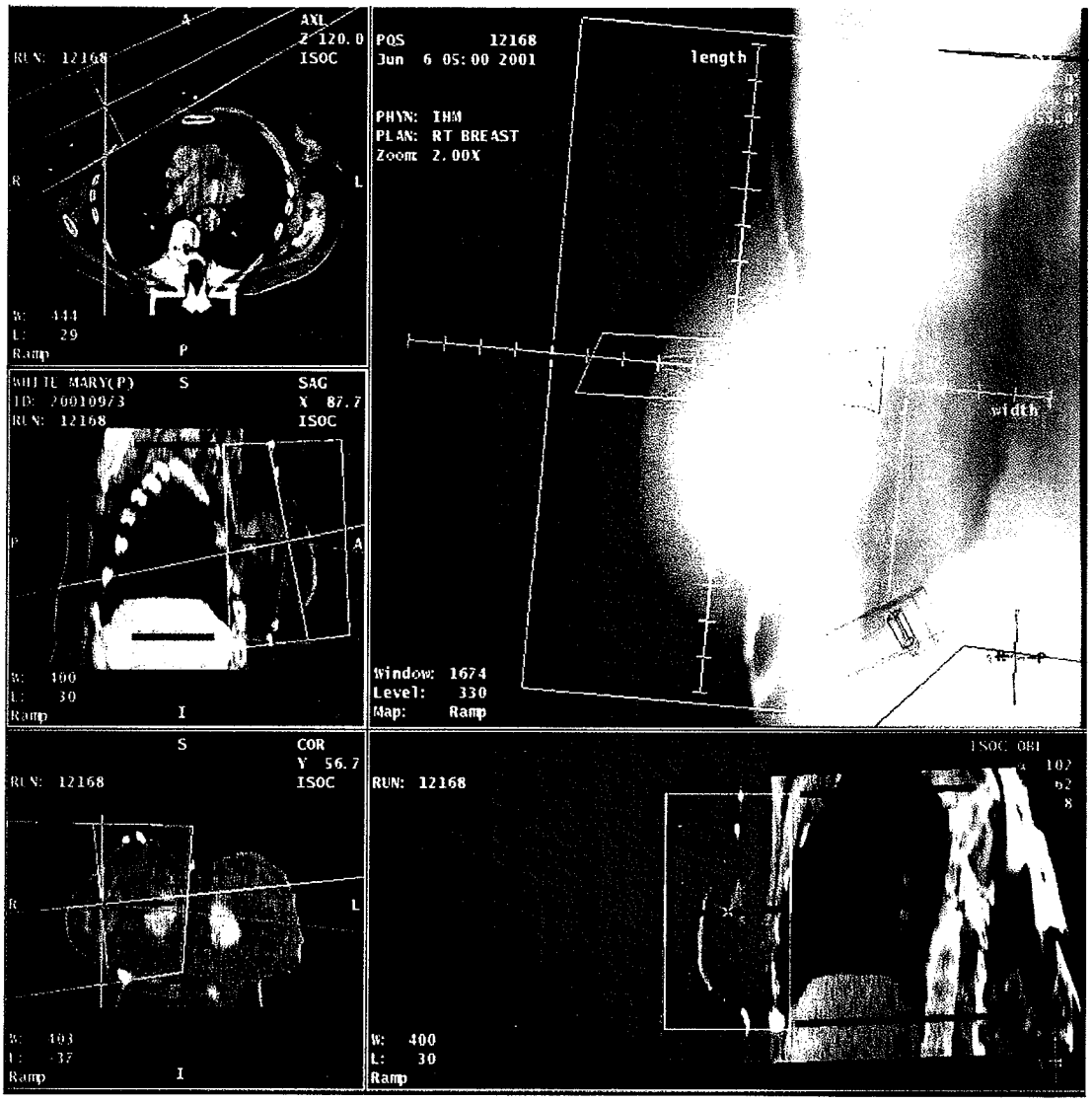

Figure 5. (a) Virtual simulation planning of tangential breast fields. Collimator and table angle to provide matching borders are obtained from multiple window views.

altering the CT window and level for lung and soft tissues. Field parameters are selected according to the breast protocol to be used and the plan is passed to the RTPS for calculation and dose optimization. The plan, including the final isocentre coordinates, which may have changed during plan optimization, is exported back to the virtual simulator for verification using DRRs. The shift coordinates are printed from the relationship between the plan isocentre and patient origin coordinates. These are transferred to the treatment machine with the plan details. Worksheets and DRRs are printed [14, 15].

Head and neck (Figure 5b)

Stage 1. Localization requires the immobilization shell to be attached to the flat CT couch in order to emulate exactly the patient positioning on the treatment machine. Careful consideration should be given to the design of the head fixation device to enable compatibility between the CT and accelerator table supports.

The scanning parameters are usually a trade-off between maximizing DRR resolution and keeping the number of slices to a manageable size (typically 3 mm slice thickness and 1.5 spiral pitch). The scanning extent is determined from the pilot (scout) view and the external contours are often produced at a remote VSIM workstation while previewing the scanned slices.

A reference slice plane is selected (purple contour in Figure 5b) and the patient origin coordinates created and transferred to the CT couch and laser. The CT longitudinal couch,

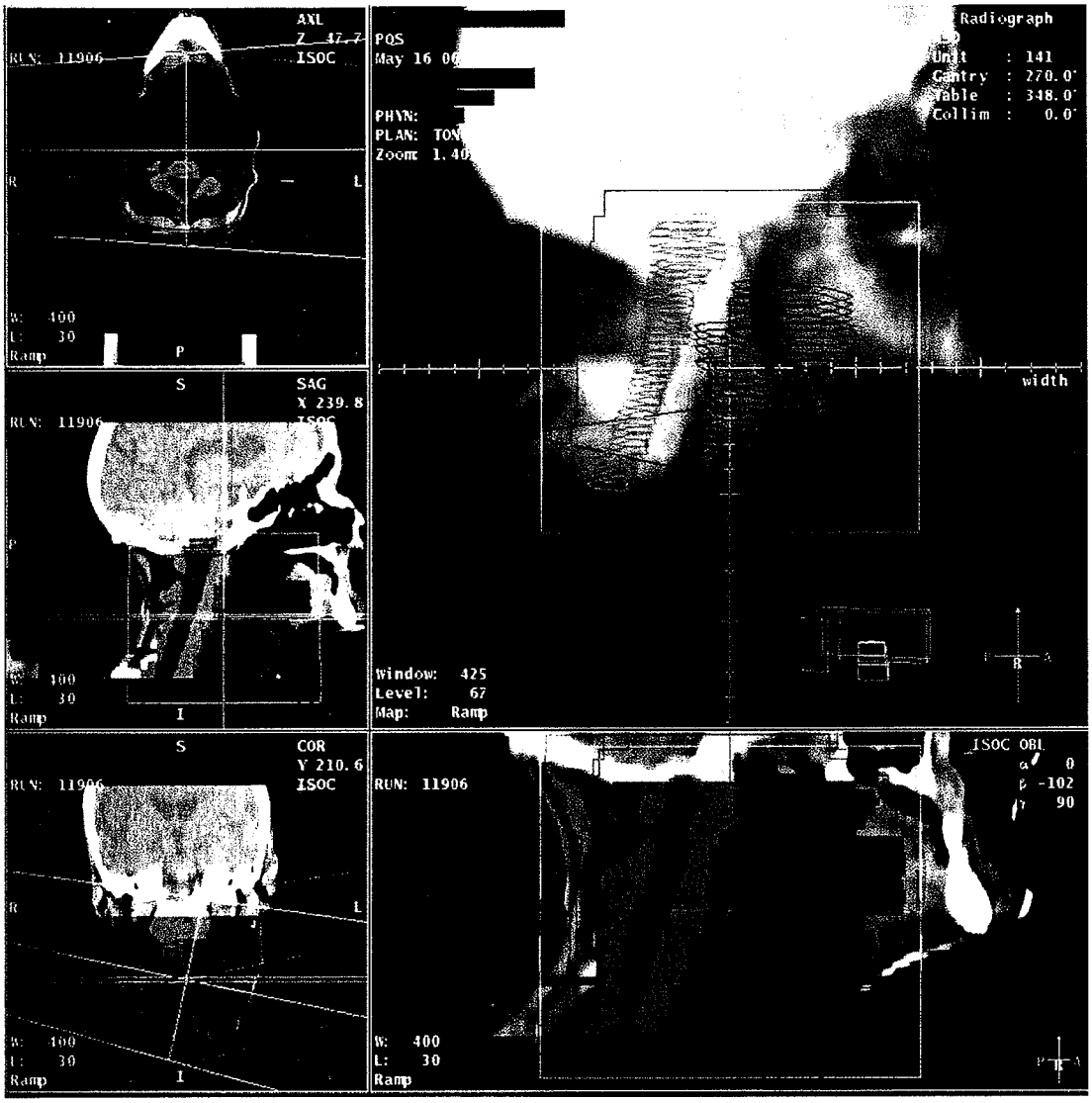

Figure 5. (b) Virtual verification of a carcinoma of the tongue. The purple triangle represents the plane containing the "patient origin" reference point from which the position of the isocentre gives the "shift coordinates".

vertical couch and sagittal laser positions are set to define the patient origin, and the patient is marked. The patient session is now finished.

Stage 2. VSIM requires marking of the GTV, CTV, PTV and organs at risk. The isocentre and field parameters can then be defined using the virtual simulator or the RTPS. The plan is sent for calculation and optimization to the RTPS and exported back to the virtual simulator for verification. The DRRs for all fields are printed (laser imager) and approved by the oncologist.

Shift coordinates are printed from the relationship between the isocentre and patient origin coordinates. These are transferred to the treatment machine with the plan details. Worksheets and DRRs are printed (Figure 5b) [16].

Bronchus (Figure 5c)

Stage 1. Localization of the patient is in the supine position with arms overhead clasping arm-poles attached to an indexed radiotherapy couch top. The scan length is customized for each patient by visual inspection within the CT aperture and from the pilot (scout) view, but generally covers the whole chest. The scan protocol is the same as for the breast. Localization and planning procedures are similar to those used for head and neck with the exception of palliative bronchus treatments. For these cases the definition of field size position and shielding can be performed by direct marking of the DRRs, being analogous to conventional physical simulation. This technique has been termed "virtual fluoroscopy" [17]. The

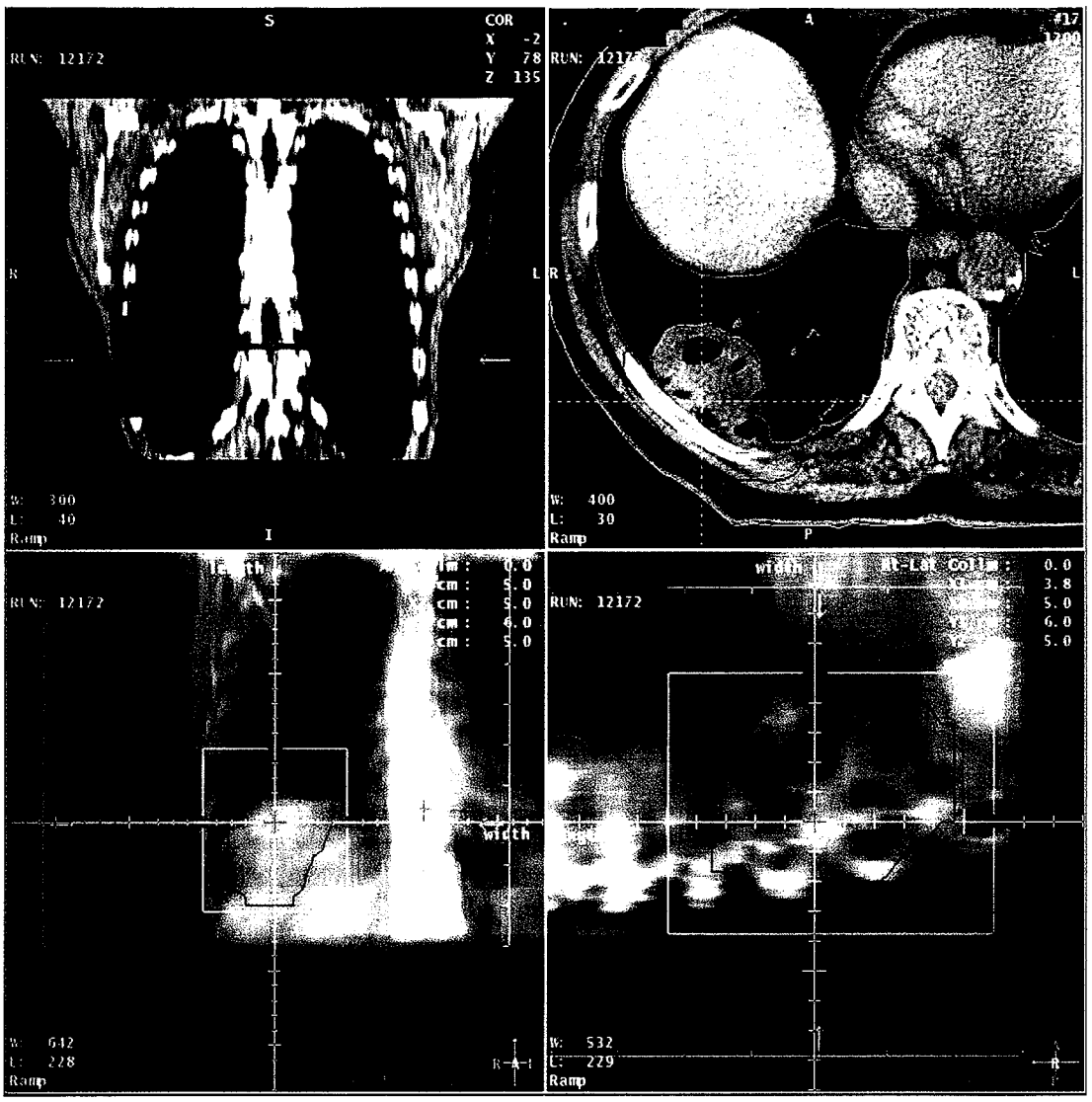

Figure 5. (c) Localization of a chest lesion using virtual fluoroscopy. Anteroposterior and lateral virtual radiographs (digitally reconstructed radiographs) show the isocentre in simulator and CT views.

effect of diaphragm movement in these cases, which cannot be easily assessed by CT sim, must be allowed for in the target margins, if a breath hold protocol is not used.

Quality assurance for CT sim

The accuracy of a conventional simulator relies on the very tight tolerances of several mechanical features, including gantry, collimator and field wires. In contrast, CT sim is highly dependent on the accuracy of the image from the CT scanner and alignment of the supporting hardware. It is still vital to perform geometric tests of the laser system, couch alignment and mechanical tolerances under load. Checks of the various network links between systems are particularly important during commissioning and following software revision.

Table 2. Acceptance tests for CT sim

Parameter	Acceptance test	Tolerance
Target localization	Contouring accuracy Isocentre calculation	<1 pixel
DRR accuracy	Divergence test	Ray-line angular displacement 0.1°

DDR, digitally reconstructed radiograph.

The quality control procedures can be split into daily and monthly procedures and those

performed at acceptance and then yearly. Acceptance tests are shown in Table 2 [18]. Special phantoms to perform these tests have been designed [19].

Daily tests should include the following laser tests to ensure that all positions and distances are within ± 1 mm:

- Alignment of external vertical and horizontal lasers and their position with respect to the virtual isocentre of the CT simulator.
- Accuracy and linearity of the sagittal laser, driven by computer or manually set.
- Alignment of the internal laser within CT aperture with respect to the scan plane.
- Couch position, vertical and longitudinal, registration.

Monthly tests, or following software upgrade, should include the following:

- Distance between known points in the image plane.
- Left/right registration.
- CT number/electron density verification.
- Noise on CT number in uniform phantom.
- Reconstructed slice location.
- Image transfer protocols, *e.g.* Dicom-RT, using standard plans.

Which to choose: CT sim or physical simulation?

Although attempting to replicate the same task, conventional and virtual simulators are very different systems with major differences in hardware. Most significantly, VSIM has a different approach to providing the clinician with information to define the target volume, which can result in significantly different treatments (beam arrangements and target volumes).

A comparison of virtual *vs* physical simulation aims at answering a number of questions. The answers to these questions are fundamental to decisions on equipment selection when either replacing an existing simulator or providing additional resources. Each question will be addressed based on published investigations and according to the authors' own experiences and opinions.

(a) *Do VSIM methods lead to the same level of treatment accuracy as physical simulation?* Two recent randomised trials have compared simulation techniques. 75 patients undergoing four-field conformal prostate treatment in a study by Valicenti et al [20] had CT sim, with one group having physical simulation prior to treatment. Both patient groups had their port films reviewed to quantify the differences between the two techniques. Results indicated no significant difference in set-up errors between the two techniques and concluded that physical verification could be omitted from the CT-based planning process. McJury et al [21] considered 86 patients undergoing palliative radiotherapy using parallel-opposed fields to the chest, all patients had CT VSIM and physical simulation but patients in each group of the study received treatment using either the CT sim or physical simulation plan. Results indicated that setup errors were typically 2–3 mm for both patient groups and there were no significant differences in terms of accuracy.

(b) *Do VSIM methods result in significant differences in target volume definition compared with physical simulation?* The primary objective of this double-blind randomized trial by McJury et al [21] was to determine the differences in target volumes contoured using both techniques. Comparing fields defined in each study arm, there was a major or complete mismatch in coverage between fields in 70% of cases. The use of VSIM resulted in field sizes on average 25% smaller than physical simulation. Senan et al [22] also found that the use of CT sim allowed for smaller planning target volumes in radical lung cancer.

(c) *Does VSIM cause problems with regard to patient throughput owing to changes in length of procedure times?* Comparing the relative time expended for CT sim and physical simulation requires an assessment of procedure time involving the patient and radiotherapy staff. A number of centres have published data on time comparisons. Buchali et al [23] have reported a study of 23 patients having tangential breast irradiation. The use of CT sim resulted in a mean saving of 22 min in the whole treatment planning process compared with physical simulation. This reduced the time interval between CT and first treatment by 31%, mainly due to the omission of conventional simulator verification from the 3D planning process. For those centres with increasing patient workloads, this economy can have a significant effect on patient throughput. However, a check by the physician is still required.

Raga et al [24] have reported that the physician's time involved in the planning process can be significantly reduced using CT sim, typically from 25 min to 5 min per patient (brain and prostate).

Mah et al [25] used CT sim for craniospinal paediatric patients, where time efficiency can improve patient comfort and increase accuracy. On average patient involvement and immobilization time during simulation could be reduced from 45 min to 20 min when using CT sim instead of physical simulation.

These results suggest that the use of CT sim with omission of conventional simulation may

improve the efficiency of the treatment planning process without compromizing accuracy. Raga et al [24] report that 60% of their planned patients were suitable for CT sim, whereas some early work by Nagata et al [26] indicated that this figure could be as high as 70%. One author's (JC) own experience indicates that 65% of planned patients are selected for CT sim.

Table 3. Disadvantages of CT simulation [1]

Disadvantage	Comment
1. A large number of CT slices are often required at $\leqslant 3$ mm thickness .....for optimal DRR resolution.	Now easily and quickly achievable. Sometimes 5 mm slices are unavoidable where large volumes are to be scanned.
2. State-of-the-art hardware is required for interactive capabilities.	Now achieved.
3. DRRs do not provide information about patient movement or anatomical movement that may be necessary for accurate field coverage.	This can be resolved partially by multiple fast scans that can be registered at different breath hold positions or slow scanning to blur movements and registration with fast scans.
4. DRR resolution is unlikely to equal radiographic film resolution.	Resolution now entirely acceptable for most uses.
5. Field portal visualisation on the patient's skin not available.	Now available on many systems using room's eye view.
6. Patients may have to be immobilised for extended periods during the virtual simulation procedure.	Scan times are now very much shorter and planning methods can be adapted to reduce the requirement for the patient's physical presence.
7. The radiotherapist needs to be present for extended periods to mark target volume.	Still true, but procedure now speeded up with effective editing systems. Mark-up can be done post-scan and utilise reference marking only.
8. Correcting (shifts) to the marked isocentre may be required before the plan is finalized.	Still true and still a concern in terms of the potential for error. Portal imaging on the treatment set provides final check; this step becomes more important.
9. Some patient positions may not be possible.	Still true, but dedicated CT scanners with large apertures may eliminate this problem.

DRR, digitally reconstructed radiograph.

Advantages and disadvantages

Many of the advantages of CT sim have been discussed in the preceding sections but can be summarized as:

- full 3D simulation allowing unique verification of beam coverage and avoidance in three dimensions,
- beams can be simulated and verified that are not possible with conventional simulation, *e.g.* vertex fields,
- the verification images, DRRs can contain more information than conventional simulation and can be manipulated to enhance tumour visualization, and
- there is a much closer connection to diagnostic information with CT sim, allowing integration of multimodality images.

When examining the disadvantages of CT sim, it is interesting to use the table from Conway and Robinson, 1997 [1], which probably represented the state-of-the-art in CT-sim 1 or 2 years earlier, as a point of comparison with the present situation (Table 3).

Conclusion

Modern CT sim allows full 3D viewing and planning of the patient, together with verification images that can be used for comparison with portal images.

The entire simulation of the patient, ensuring all beams are achievable and safe, makes use of room's eye view and anti-collision software algorithms.

CT sim enables doctors and dosimetrists to work at their convenience while minimizing patient attendance. However, for some palliative treatments the planning process using CT sim might be prolonged compared with physical simulation.

The adoption of CT VSIM in favour of conventional simulation is recommended where small oncology departments have a requirement for only one simulator while expanding their 3D treatment planning methods. For larger departments the retention of conventional simulation would seem advantageous, and a ratio of two CT sim units to one physical simulation unit would provide the balance of resources for the precision required in a modern radiotherapy department.

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ARTICLE

Improvements in radiotherapy practice: the impact of new imaging technologies

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Abstract

Improvements in imaging technology are impacting on every stage of the radiotherapy treatment process. Fundamental to this is the move towards computed tomography (CT) simulation as the basis of all radiotherapy planning. Whilst for many treatments, the definition of three-dimensional (3D) tumour volumes is necessary, for geometrically simple treatments virtual simulation may be more speedily performed by utilising the reconstruction of data in multiple imaging planes. These multi-planar reconstructions may be used to define both the treatment volumes (e.g. for palliative lung treatments) and the organs at risk to be avoided (e.g. for para-aortic strip irradiation). For complex treatments such as conformal radiotherapy (CFRT) and intensity-modulated radiotherapy (IMRT) where 3D volumes are defined, improvements in imaging technologies have specific roles to play in defining the gross tumour volume (GTV) and the planning target volume (PTV). Image registration technologies allow the incorporation of functional imaging, such as positron emission tomography and functional magnetic resonance imaging, into the definition of the GTV to result in a biological target volume. Crucial to the successful irradiation of these volumes is the definition of appropriate PTV margins. Again improvements in imaging are revolutionising this process by reducing the necessary margin (active breathing control, treatment gating) and by incorporating patient motion into the planning process (slow CT scans, CT/fluoroscopy units). CFRT and IMRT are leading to far closer conformance of the treated volume to the defined tumour volume. To ensure that this is reliably achieved on a daily basis, new imaging technologies are being incorporated into the verification process. Portal imaging has been transformed by the introduction of electronic portal imaging devices and a move is underway from two-dimensional (2D) to 3D treatment verification (cone beam CT, optical video systems). A parallel development is underway from off-line analysis of portal images to the incorporation of imaging at the time of treatment using image-guided radiotherapy. By impacting on the whole process of radiotherapy (tumour definition, simulation, treatment verification), these new imaging technologies offer improvements in radiotherapy delivery with the potential for greater cure rates and a minimum level of treatment side effects.

Keywords: *Radiotherapy treatment planning; virtual simulation; image registration; treatment verification.*

Introduction

The process of radiotherapy has been likened to a chain, with the whole process being only as strong as its weakest link. Each of these links (tumour definition, simulation, treatment planning, treatment delivery) can be strengthened and enhanced by improvements in imaging technologies. This paper aims to provide an overview of the role modern imaging plays in radiotherapy planning and delivery, with an eye to the advances on the horizon which may soon enter routine clinical practice.

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The conventional simulator

The radiotherapy simulator is a diagnostic X-ray tube, mounted to reproduce the geometric movements of a radiotherapy treatment machine and capable of imaging with both fluoroscopy and plain X-ray film. The imaging produced is intrinsically two-dimensional (2D), and three-dimensional (3D) information can only be obtained by taking orthogonal X-ray films. Whilst still in routine use in radiotherapy, the simulator is rapidly being replaced by the computed tomography (CT) scanner as the standard means of locating the tumour for both radical and palliative radiotherapy treatments. The information derived through CT is inherently 3D and contains both contour and tissue density information which is invaluable during the planning process. Although stand-alone CT scanners may be used, a trend is growing for radiotherapy planning to be performed using dedicated CT simulators. These comprise of a CT scanner, a laser marking system and a 3D workstation to allow the manipulation and visualisation of the CT data for radiotherapy treatment localisation. This process is called virtual (or CT) simulation.

Virtual simulation

Most CT simulators are based upon standard diagnostic CT scanners but as the market has grown, so scanners have been developed which are tailored to the specific needs of radiotherapy. The main feature of these scanners is the increased aperture size (up to 85 cm) allowing the use of patient immobilisation devices not possible with traditional diagnostic scanners (typically 65–70 cm bore). The increased source–detector distance on these larger scanners slightly increases both the noise levels of the scans and the patient dose, but these increases are of the order of a few percent only, and have little diagnostic or clinical impact[1].

For a thorough description of the computer technology underpinning virtual simulation, see Aird and Conway[2]. In essence, the virtual simulator uses CT data and a 3D computer workstation to replicate the localisation process undertaken in the conventional simulator. This process includes the selection of field sizes, gantry angles and other machine parameters to define treatment beams with the appropriate target coverage. The fluoroscopy image and the X-ray film are replaced by the digitally reconstructed radiograph (DRR). In addition to replicating the functionality of the conventional simulator, the virtual simulator allows visualisation of the field apertures in relation to the 3D CT data. These data may be viewed as conventional axial CT slices or may be reconstructed in other planes, such as coronal or sagittal slices (Fig 1). This ability to reconstruct the data as multi-planar images (multi-planar reconstructions, MPR) is one of the main advantages of virtual simulation.

Simple field design

The simplest method of virtual simulation is to model the methods used with the conventional simulator. With this approach, the first step is to position the treatment fields on the DRR, and the axial scans and the MPRs are then used to assess the field coverage of the target. A good example of the use of this method is tumour localisation in palliative radiotherapy for non-small cell lung carcinoma (NSCLC). The inadequacies of conventional simulation for localising treatment for this patient group have been demonstrated in a prospective study of 86 patients by McJury *et al.*[3]. When they compared the fields defined by conventional and virtual simulation, they found a major mismatch in 2D field coverage in 66.2% of patients, and a complete match in only 5.2% of patients. We have performed a study of 10 patients comparing the 3D tumour volume coverage of conventional and virtual simulation for NSCLC. Again it was found that conventional simulation appeared inadequate for a significant number of patients within the group, particularly those with large or medially placed tumours. The localisation method used did not involve the definition of 3D tumour volumes and is demonstrated by Fig. 1. Part (a) shows the field placement on the anterior DRR and parts (b) to (d) show how the tumour volume may be visualised on the axial view and on the coronal and sagittal MPRs. In particular the coronal MPR can be very useful for verifying the position of shielding (in this case with multi-leaf collimator, MLC). In practice, the MPRs are viewed interactively by scrolling through the CT data, allowing an appreciation of the 3D target coverage achieved. However, it must be remembered that the coverage observed is the *field* coverage, and dosimetric coverage must be inferred from this (as with the conventional simulator).

In addition to accurately localising the tumour volume, it is equally important to define any radiosensitive normal tissue structures which may limit the volume to be treated or the dose delivered. These are called the organs at risk (OAR). These organs may be delineated on axial scans to make a 3D volume with appropriate margins, or they may be visualised using the same imaging tools utilised during virtual simulation—namely the DRR, axial scans and MPRs. A good example of OAR which have an impact on the target volume definition are the kidneys in radical prophylactic para-aortic lymph node irradiation for Stage I seminoma of the testis. The treatment aim is to include the para-aortic lymph nodes and the renal hilar nodes on the ipsilateral side, but to exclude both the contralateral and ipsilateral kidneys. Traditionally, these patients are conventionally simulated using IV contrast used to visualise the kidneys. An alternative method of field localisation is to use virtual simulation. Using this method, a full 3D data set is obtained which allows both the more accurate targeting of the treatment area (including the renal hilum) and also visualisation of the

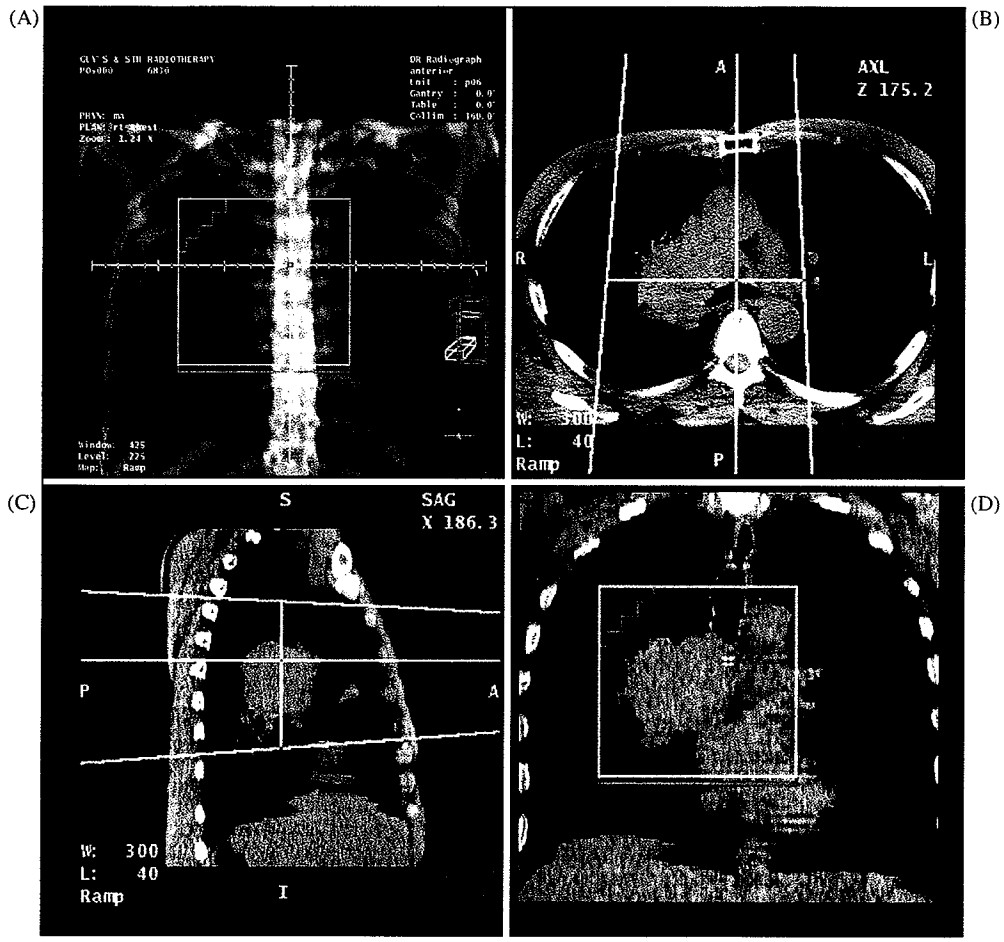

Figure 1 **Virtual simulation for non-small cell lung carcinoma (NSCLC). (A) Anterior DRR; (b) axial slice; (C) sagittal MPR; (D) coronal MPR.**

kidneys without the use of invasive IV contrast. The localisation of the kidneys may be achieved either by outlining on axial scans to create a composite volume or by interactively visualising them on the coronal MPR (Fig. 2). It may be seen that a comparable view is achieved by both methods, but with a significant time saving using the MPR method.

Conformal radiotherapy and intensity-modulated radiotherapy

Recent improvements in radiation oncology technology have enabled greater conformality of the treated volume to the target volume of disease. For many tumour sites it is becoming accepted practice to geometrically shape the treatment beams to deliver a 3D high-dose volume around the tumour whilst avoiding critical OAR nearby. This is termed conformal radiotherapy (CFRT). Intensity-modulated radiation therapy (IMRT) not only shapes the beams geometrically but modulates the fluence of the beams providing improved dose deposition with the possibility of both concave and convex isodose distributions. These techniques have been shown to reduce normal tissue morbidity in randomised clinical trials[4–6] and have the potential for dose escalation to the tumour and improved patient cure[7].

However, in order to implement CFRT and IMRT it is essential that both the tumour volume and any OAR are precisely located and defined. Whilst the localisation of treatment fields without defining target volumes (i.e. using only the DRR, axial scans and MPRs) is acceptable for geometrically simple treatments (parallel opposed fields), it is often not adequate for complex treatment techniques. Here, the accepted approach is to use CT data to localise radiotherapy treatment by outlining the target volume on each axial scan. The union of these 2D volumes over the whole data set results in a 3D target volume. The initial target volume to be drawn is usually the gross tumour volume (GTV), so named as it contains

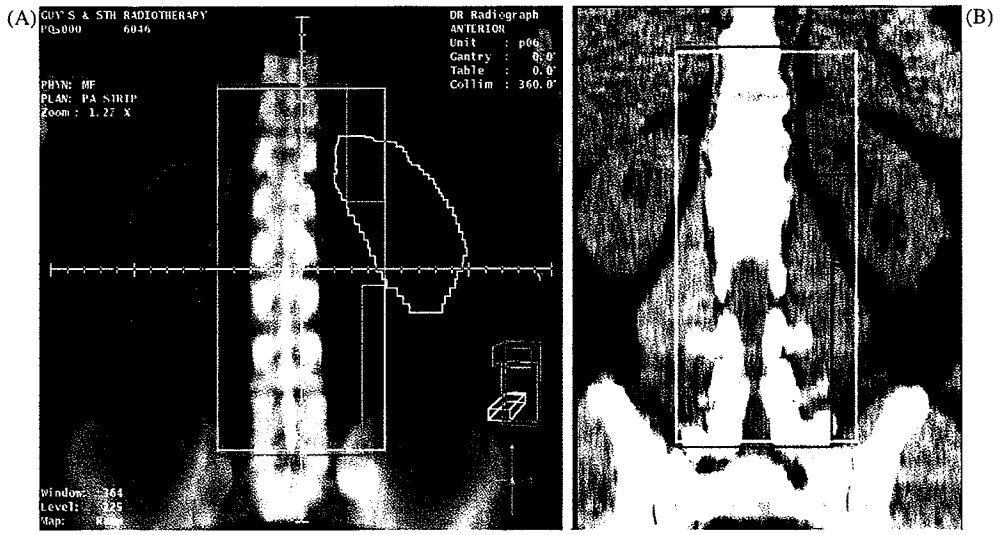

Figure 2 **Virtual simulation for para-aortic strip irradiation. (A) Anterior DRR with kidneys outlined; (B) coronal MPR with kidneys visualised.**

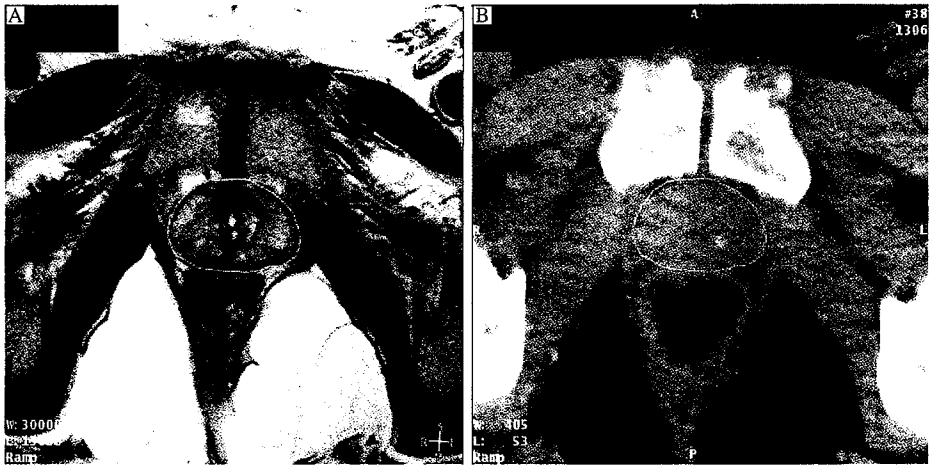

Figure 3 **Registered MRI (A) and CT (B) images of the prostate gland. (A) T2 weighted MRI; (B) CT.**

the gross extent of the tumour identifiable with the available clinical and imaging data. To ensure adequate coverage of any sub-clinical (i.e. non discernible) spread, a 3D margin may be added around this GTV to give the clinical target volume (CTV). In turn, a further margin is added around this CTV to account for all the technique-dependent variations such as set-up inaccuracy, internal organ motion and treatment machine parameters, which may result in an inadequate dose coverage of the CTV. The resulting volume is called the planning target volume (PTV). This process is described in detail in the ICRU Report 50[8]. One advantage of following this procedure is that margins may be added specifically to account for variability due to the treatment site and the imaging modality used for treatment localisation. Against the strong benefits of this system of volumes and margins is the disadvantage of the time-consuming nature of the 3D voluming. Improvement in imaging technology with the development of multi-slice scanners capable of capturing hundreds of axial slices at a time will only add to the time burden of manual volume delineation. The prospect of inherently 3D volume rendering technologies has been raised[9], but currently these are restricted to the definition of OAR and not applicable to tumour volume definition. A novel alternative to defining the tumour volume on each axial slice has been proposed for radical radiotherapy to the prostate. Valicenti *et al.*[10] investigated the use of 'thin tissue' DRRs, where the volume of CT data used is restricted to a 1–1.5 cm section through the proposed target. In this way, the prostate

may be clearly visualised against the surrounding normal anatomy and localisation times were reduced to less than 5 min. Whilst this is an interesting approach which mirrors the use of the MPRs for target localisation, in this patient group it did require the administration of both bladder and rectal contrast in order to achieve sufficient tissue definition on the DRRs.

Defining the GTV and OAR

As already described, for reasons of good anatomical visualisation, fast data acquisition and useful tissue density information, the CT scanner has become the foundation of 3D imaging in radiotherapy planning. Whilst for some tumour sites (e.g. lung, bladder, oesophagus) CT is the imaging modality of choice, for other tumour sites it is less well suited. In particular, there are a number of tumour sites where magnetic resonance imaging (MRI) is the optimum modality for delineating the soft tissue extent of tumour. Rasch *et al.*[11] showed that the impact of incorporating MRI into prostate treatment planning is dramatic with the target volume being on average 30% smaller using MRI compared with CT. The MRI-defined prostate is systematically 7 mm smaller at the posterior aspect (seminal vesicles) and 6 mm at the apex. However, the direct use of MRI for radiotherapy planning has some potentially serious disadvantages: geometric distortion of the image, lack of tissue density information, poor definition of bone, lack of DRR formation and dependency of imaging on scan settings. Despite these problems, attempts have been made to use MRI alone for radiotherapy treatment planning for the prostate. Lee *et al.*[12] used MRI scans with bulk density information assigned for soft tissue and bone, and showed that there were negligible differences in the dosimetry when compared with CT-based planning. The authors did conclude, however, that more work was needed to define MRI protocols which gave sufficient definition of the prostate whilst minimising geometrical distortion. In order to incorporate MRI data into the planning process, it is therefore necessary to register or fuse the MRI and CT data. Commonly this is achieved through matching the fixed bony anatomy visualised on CT with that seen on MRI. However, the reliability of the image registration depends strongly on the protocols followed for CT and MRI acquisition. Ideally the same immobilisation devices should be used, and any bowel or bladder filling protocols should be applied. Fig. 3 shows the extra detail which may be gained through T2-weighted MRI scans of the prostate compared with the planning CT scan, but it may be noted that rectal filling between the two scans has not been well maintained, leading to potential discrepancies in prostate position within the pelvis. It has been very well established that there is both inter-fraction motion of the prostate between radiotherapy treatments[13] and intra-fraction movement during each treatment[14]. This highlights a significant problem with the use of bony landmarks for MRI/CT registration, as any inter- and intra-fraction motion of the prostate relative to bony anatomy may also occur between the CT and the MRI. The impact of this may be seen in Fig. 4. The larger volume is the CT-defined prostate GTV (solid blue) and within this is seen the MRI-defined prostate GTV (solid pink). The full rectum (wire frame) at the time of the CT scan is seen posterior to the prostate. It is notable that the MRI-defined prostate is in general smaller than the CT-defined prostate but lies more posteriorly at the superior end, probably due to the differences in rectal filling between the two scans (as seen in Fig. 3). An alternative approach to registration using bony anatomy is to perform image registration using implanted intra-prostatic gold grains[15]. This appears to be a very acceptable method of image registration for prostate radiotherapy as these internal fiducial markers are already in common use for treatment verification (see verification section).

Figure 4 **Three-dimensional view of the CT-defined prostate (blue) and MRI-defined prostate (pink). CT-defined rectum is shown as wire frame blue.**

In addition to imaging modalities which provide enhanced anatomical information, there is currently an increasing appreciation of the potential benefits of incorporating *functional* imaging into the localisation process. This imaging may allow progress from physical conformality of the treatment to a level of biological conformality. For example, using positron emission tomography (PET) or nuclear magnetic resonance imaging (NMR), it may be possible to alter the dose levels across the target volume to boost the dose specifically to hypoxic areas of the tumour[16]. Advances are likely to accrue from the use of functional imaging using PET and single photon emission computer tomography (SPECT) scanning at sites such as the lung, head and neck and lymphomas. Again, these images must be fused with CT or segmented MRI data for direct radiotherapy

planning[17,18]. In patients with NSCLC, PET has been shown to define the lymph node target volume more accurately[19], and may lead to a more consistent definition of the GTV[20]. A potential difficulty is the lack of anatomical information contained within PET scans, meaning that image registration with CT can be problematic[21]. For this reason there is a move towards combined PET/CT scanners which remove the need for anatomical registration of the images. The use of combination PET/CT scanners will allow evaluation of direct integration of PET data into the delineation of the GTV at a number of tumour sites to see if it reduces geographical miss and produces better local control and lower tissue morbidity[22]. Already there is some evidence that in patients with head and neck cancer, lung cancer and various pelvic tumours, PET/CT has a significant impact both on the size of tumour volumes and on the degree of variability between clinicians in delineating disease[23]. Additional studies would be helpful to investigate the correlation between true tumour extension on histopathological specimens after surgery and the activity detected on PET scanning and morphological changes seen on CT.

In addition to more accurately localising the tumour volume, PET has also demonstrated its utility in excluding OAR from the treatment volume. Nishioka *et al.*[24] used fluorine-18-labelled fluorodeoxyglucose (^{18}F-FDG)-PET images co-registered with MRI and CT in a group of 21 patients with nasopharyngeal and oropharyngeal tumours. They found that parotid sparing became possible in 15 of the patients whose upper neck area near the parotid glands was tumour-free on ^{18}F-FDG-PET. Functional MRI (fMRI) has also shown its potential to aid in the definition and exclusion of OAR, particularly during intracranial irradiation. By performing fMRI studies whilst the patient performs set tasks (such as moving their fingers) it may be possible to minimise the possibility of loss of critical neurological functions[25].

Defining the PTV

Once the GTV/CTV have been defined, it then becomes necessary to ensure that a PTV margin is added which will allow confidence in the dosimetric coverage of these target volumes. There are many factors that contribute to this margin, including internal organ motion, daily set-up, machine geometry and the treatment planning system. This section will focus on the quantification and reduction of uncertainties inherent in the localisation process, and the next section will focus on those due to treatment variabilities.

Due to the speed of multi-slice spiral CT scanners, the entire thorax may now be imaged over one to two normal respiratory cycles. Each part of the scan therefore represents a snapshot of the patient's anatomy and tumour position during a particular phase of their respiratory cycle. As scanners increase in speed so the number of respiratory cycles sampled decreases. This positional uncertainty due to patient respiration may be resolved in either of two ways. The uncertainty may either be reduced (by respiratory control or treatment gating), or carefully measured and incorporated into the planning process. A novel solution to measuring the uncertainty, developed by Sixel *et al.*[26], is to incorporate a digital fluoroscopy unit into the CT gantry. Their study of 10 patients undergoing radical radiotherapy for NSCLC found that the motion recorded for each patient was unique, and could not be predicted from the position of the tumour within the chest. The group found that a standard PTV margin of 15 mm would often be inadequate in the cranio-caudal direction, and unnecessarily large laterally. It is, however, a necessary requirement of this system that the tumour can be visualised on fluoroscopy. An alternative approach to measuring tumour motion during respiration is to perform multiple CT planning scans. Lagerwaard *et al.*[27] investigated the use of three 'slow' CT scans of the tumour volume and compared them to the data gathered from three fast scans. Each slice of the slow CT scans took 4 s, allowing capture of a whole respiratory cycle. The tumour volumes defined using the slow scans were predictably larger than with the fast scans, but also demonstrated less variability than the volumes delineated on the fast scans.

Whilst for some patient groups (e.g. those with poor lung function), quantifying and incorporating respiratory motion may be acceptable, for other types of treatment the goal must be reduction of the uncertainty. This is particularly true of IMRT treatments where the dose delivered may be built up by many small field segments over a prolonged daily treatment. Motion of the target can potentially disrupt the addition of these individual dose segments leading to an increased dose inhomogeneity across the target. This may be a particular problem where respiratory motion is a factor, such as IMRT treatment to the lung and breast. A potential solution to this problem is to gate the treatment in time with the respiratory cycle of the patient. This may be done by either monitoring the respiratory cycle, or by restricting respiration mechanically. The latter option includes a range of active breathing control (ABC) devices, which have shown a surprising degree of patient compliance and have been used particularly effectively for breast radiotherapy. An important additional advantage of this approach for breast radiotherapy is the reduction of both lung and heart dose by elevation of the breast away from underlying structures during deep inspiration[28]. In addition, in lung radiotherapy, the diagnostic quality of the imaging is improved by gaining CT information whilst the patient is in breath hold. Due to the increasing capability of modern linear accelerators to achieve beam stability over small numbers of monitor units, gating the treatment in time with the patient's natural respiratory cycle is now a possibility. A device similar to that used

for ABC may be used, but increasingly interest is being shown in the possibility of using computer imaging to monitor the respiration of the patient with no physical intervention. Fig. 5 shows a view captured from a video-based system capable of capturing real-time views of the patient during respiration. Limits may be defined on the acceptable phases of the respiratory cycle for the treatment to be delivered and the software may then gate the treatment delivery automatically. Whilst this may not be applicable in a dynamic IMRT setting, it may be useful for step and shoot IMRT or treatment utilising conventional static fields.

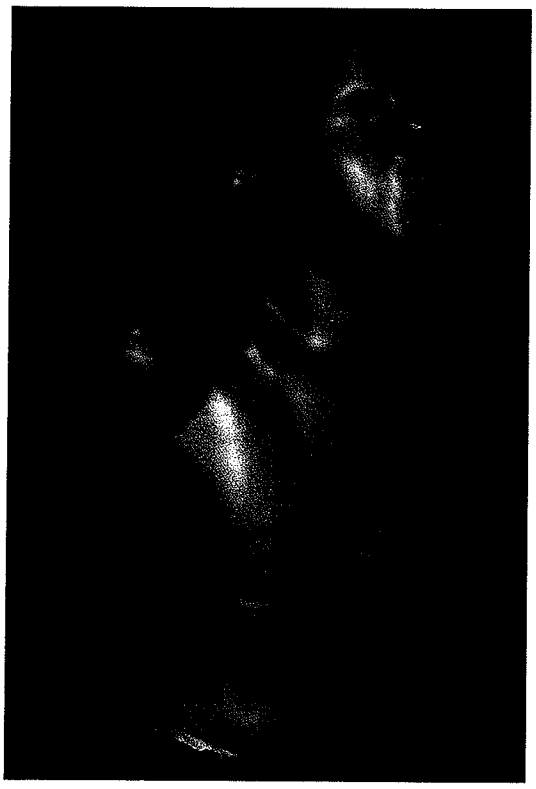

Figure 5 **Real-time capture of patient contour during simulation. Courtesy of Vision RT Limited.**

Treatment verification

Effective radiotherapy depends upon consistently and reliably irradiating the CTV to the curative prescribed dose and reducing the irradiation of the OAR to an acceptable level. These two goals may be in conflict and the definition of a large CTV-PTV margin to ensure good CTV coverage will often lead to an unacceptable dose to the OAR. It is therefore of primary importance to ensure both the accuracy of this margin and that it is reduced to the minimum possible. A significant component of this margin is the positional uncertainty due to daily set-up variations, and this uncertainty can be both quantified and minimised through effective treatment verification.

A traditional approach is to use the exit of the radiotherapy treatment beam to produce imaging of the field isocentre. Due to the geometrical compatibility of the treatment machine and the simulator, these films may be compared directly with the simulator films or DRRs. More recently, X-ray film has been replaced by electronic portal imaging devices (EPID) which allow a real-time visualisation of portal views. Both of these methods utilise comparison of the position of bony anatomy within the treatment field, but due to the predominance of Compton scatter rather than the photoelectric effect at treatment energies, bone may be poorly visualised.

An alternative approach is to use implanted gold grain fiducial markers, for instance in the prostate gland, which may be more easily visualised on portal imaging[29]. It is a necessary assumption of this technique that the position of the gold grains inside the prostate remains constant. This has been verified by comparing the relative position of three implanted gold grains in 11 patients over the course of their radical prostate radiotherapy[30]. It was found that the average seed movement was less than 1.5 mm and in those patients where it was significantly greater (three patients), this was due to shrinkage of the prostate over the course of treatment. By incorporating a diagnostic X-ray system into the linear accelerator gantry mounting, it is possible that the position of implanted markers may be tracked in real-time and used to gate the radiotherapy treatment. Shirato *et al.*[31] showed that using such a system for radical lung treatments, it was possible to reduce the range of tumour motion during radiotherapy from 9.6–38 mm (during normal respiration) to 2.5–5.3 mm (when gated). Cone beam CT is a further development designed to take advantage of the addition of kilovoltage imaging into the treatment room. Through this technique, volumetric images of the treatment site may be gathered from one rotation of the gantry mounting. Although still early in the development of these systems, they offer the possibility of full 3D treatment verification whilst the patient remains on the treatment couch. These new imaging technologies are now grouped under the generic term of image-guided radiotherapy (IGRT).

While much of the drive towards IGRT has been through the use of X-ray-based imaging (both megavoltage and kilovoltage), there is a separate approach utilising optical imaging of external markers, or in some systems the whole patient contour. Whilst these systems have the common drawback that the relationship between external markers and internal tumour position must be inferred, they benefit in the lack of additional patient dose and the speed and ease of image acquisition. These systems may additionally be useful during the initial process of patient positioning on the couch. Fig. 6 shows a view derived from a video-based system, with the surface data from the simulator shown in pink and the treatment room shown in green. As the patient positions converge, so this may be easily visualised on the real-time display.

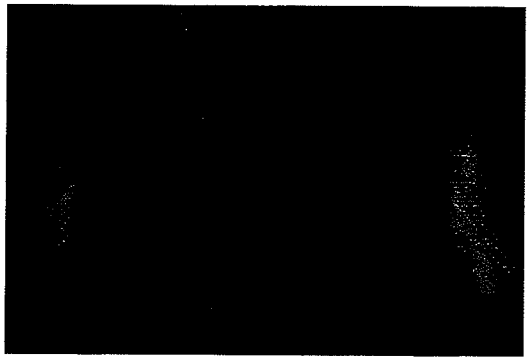

Figure 6 **Real-time alignment of 3D patient contour. Pink is patient contour at simulation; green wire frame is patient contour at treatment. Courtesy of Vision RT Limited.**

Conclusion

The wealth of 'state of the art' imaging that is now available to define the GTV has to be harnessed accurately in order to ensure that it is used to improve patient cure using highly sophisticated CFRT and IMRT. New advances in technology such as multileaf collimation, electronic portal imaging, combined PET/CT scanners and cone beam CT megavoltage treatment units are all adding to the promise of further improvements in the future.

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Localization: conventional and CT simulation

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ABSTRACT. Recent developments in imaging and computer power have led to the ability to acquire large three dimensional data sets for target localization and complex treatment planning for radiation therapy. Conventional simulation implies the use of a machine capable of the same mechanical movements as treatment units. Images obtained from these machines are essentially two dimensional with the facility to acquire a limited number of axial slices to provide patient contours and tissue density information. The recent implementation of cone beam imaging on simulators has transformed them into three dimensional imaging devices able to produce the data required for complex treatment planning. The introduction of computed axial tomography (CT) in the 1970s was a step-change in imaging and its potential use in radiotherapy was quickly realised. However, it remained a predominantly diagnostic tool until modifications were introduced to meet the needs of radiotherapy and software was developed to perform the simulation function. The comparability of conventional and virtual simulation has been the subject of a number of studies at different disease sites. The development of different cross sectional imaging modalities such as MRI and positron emission tomography has provided additional information that can be incorporated into the simulation software by image fusion and has been shown to aid in the delineation of tumours. Challenges still remain, particularly in localizing moving structures. Fast multislice scanning protocols freeze patient and organ motion in time and space, which may lead to inaccuracy in both target delineation and the choice of margins in three dimensions. Breath holding and gated respiration techniques have been demonstrated to produce four-dimensional data sets that can be used to reduce margins or to minimize dose to normal tissue or organs at risk. Image guided radiotherapy is being developed to address the interfraction movement of both target volumes and critical normal structures. Whichever method of localization and simulation is adopted, the role of quality control is important for the overall accuracy of the patient's treatment and must be adapted to reflect the networked nature of the process.

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The development of the delivery of radiation therapy is closely related to the accuracy with which the target tumour can be located with respect to surrounding anatomical structures. In recent years, the increase in computing power and the development of refined computer graphics have resulted in the ability to perform complex treatment planning in three dimensions and to manipulate images in real time. Early simulators were machines capable of the same mechanical movements as treatment units and were used to confirm treatment set up rather than for localization [1, 2]. Simulators that were developed commercially in the 1960s had the addition of fluoroscopy that was used to set the isocentre with the aid of remotely controlled movements of the couch. Field portals adequate to encompass the target volume to be treated could also be set by remote adjustments to the field defining wires. The introduction of computed axial tomography (CT) scanning in the 1970s was a step change in the ability to define tumours in relation to normal anatomy, and over the ensuing years has been widely adopted in tumour localization. Today it may be used in conjunction with complex graphics software as a virtual simulator. However, the conventional simulator still retains its place in many radiotherapy departments for localization of some tumour sites, either as a result of lack of sufficient access to a CT scanner or for relatively simple techniques not requiring the production of a dose plan. The conventional simulator is also frequently used to verify the more complex treatment plans, producing an image corresponding to a beam's eye view (BEV) from the treatment planning system (TPS) or by verifying the isocentre location from orthogonal films.

Brief history

Mould [3] describes the development of simulation, from the use of diagnostic radiographs and skin marks in the 1950s to the introduction of virtual simulation in the 1980s. In 1973, Hounsfield and Ambrose [4, 5] published their work on computerized transverse axial tomography and the potential uses of CT in radiotherapy were quickly recognized [6]. However, access to a CT scanner was often very limited, and in many cases the scanner was not even in the same hospital as the treatment facilities. In addition, a CT scanner was principally a diagnostic tool with limitations for treatment planning imposed by the small aperture and the design of the

couch, which frequently prevented the patient from being scanned in the treatment position. Harrison and Farmer [7] recognized the usefulness of being able to acquire a cross-sectional image of the patient in the treatment position using a simulator as a CT scanner and went on to describe the implementation of their idea using a fluorescent screen and an Isocon camera [8]. A number of other adaptations of the simulator to produce cross-sectional images were also proposed at this time [9–12]. This functionality was called Sim-CT and became standard on simulators in the 1990s, but the system had its limitations:

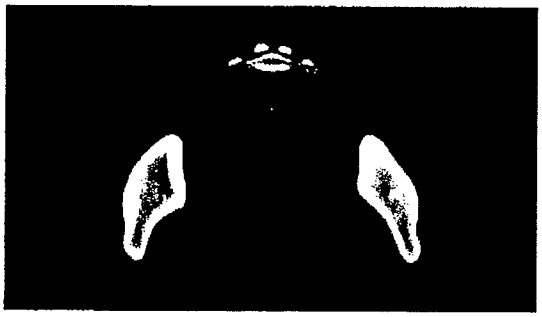
1. The heat capacity of the X-ray tube generally meant that only a few slices could be scanned;
2. The time taken to scan was limited to approximately one revolution per minute, which introduced motion artefacts resulting in images that were of a poorer quality than those produced on a diagnostic scanner;
3. The uncertainty in the Hounsfield units (HU), which depends on the field of view and the phantom/patient size, a result of the beam hardening in the unfiltered X-ray beam from the simulator CT. However, the uncertainty in HU is translated into dose variation not exceeding 3% for photon beams in the range 6–18 MV [13];
4. The relatively high dose to the patient which was shown to be approximately 10 times that delivered with a diagnostic scanner under similar conditions [14].

In spite of its limitations, the Sim-CT was a useful tool for planning in a department with limited access to a diagnostic scanner. It was a more accurate way of producing a patient outline than manual methods using callipers and flexicurves and enabled CT numbers to be converted to relative electron densities for tissue inhomogeneity corrections to be applied to a single CT slice in dose calculations. The dose distributions and monitor unit calculations showed good agreement with those obtained with diagnostic scan data [14].

In 1998, Cho et al [15] described the application of digital technology to a radiotherapy simulator in which the imaging system was replaced by a digital spot imager (DSI). The DSI consisted of an image intensifier, digital image processing, display and data transfer facilities. The images were stored during acquisition for later archiving or transfer to workstations. Simulator manufacturers now offer digital capabilities on their machines and conventional image intensifiers have been replaced by flat panel amorphous silicon (aSi) detectors. Their longevity in this application has to be proved and it is possible that the need for regular replacement may have significant revenue consequences. The most recent simulators include anatomical protocol selection, automatic correction for image distortion, last image hold, multileaf collimator (MLC) verification, a variety of image viewing and manipulation tools with annotation, image printing to film or paper, Digital Image Communications in Medicine (DICOM) export to TPS, electronic portal imaging device (EPID), record and verify, and patient management systems. The image manipulation tools enable adjustments to be made to field parameters and image quality on the last-held image, which reduces the screening time and hence patient dose compared with non-digital systems. A wide aperture (typically 90 cm) CT option is available. However, because of the restriction on gantry rotation speed, acquisition times are still slow and reconstruction time does not match that of a diagnostic scanner. In an attempt to overcome this, volume or cone beam CT (CBCT) has been developed. A number of authors describe cone beam reconstructions, based on Feldkamp's original back projection algorithm [16], for the acquisition of volumetric data [17–19].

When first proposed, the size of the detector was a severe limitation on the reconstruction volume and, although promising results were obtained, its use in treatment planning was not realised until aSi flat panel detectors of a reasonable size became available. Commercial systems are now available. For example, the Acuity (Varian, Palo Alto, CA) with cone beam option gives a cone of 17 cm at the isocentre but with added penumbra of 1.9 cm at either end regardless of the scan length. It is therefore not appropriate to acquire a single narrow slice. A single slice takes 45 s and 675 images are acquired per rotation. Early reports (private communications, A Vinall, K Venables, 2005) suggest that the geometric performance and image quality are adequate for radiotherapy planning purposes although the images are not of diagnostic quality. The rotation time of 45 s does, however, result in significant movement artefacts. Figure 1a shows the streaking that results from the movement of bowel gas during the acquisition of a CBCT scan compared with a CT planning scan.

(a)



(b)

Figure 1. (a) Movement artefacts on an axial slice of a CBCT scan as a result of movement of bowel gas. (b) An axial slice from a planning CT of the pelvis for comparison. (Courtesy of Varian Medical Systems, Palo Alto, CA and Memorial Sloan-Kettering Cancer Centre).

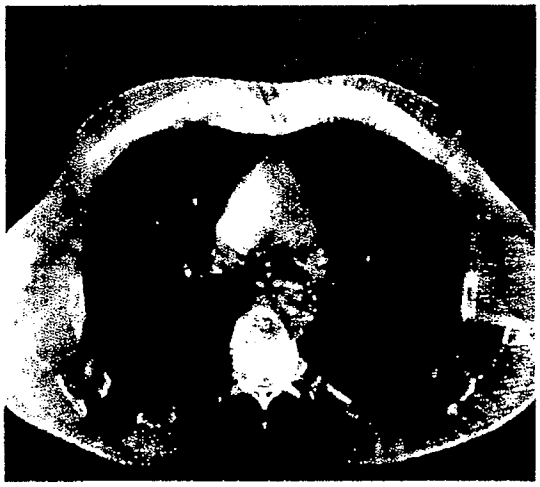


Figure 2. Movement artefacts on an axial slice from a CBCT acquired during normal breathing. (Courtesy of Varian Medical Systems and Hirslanden Klinik, Aarau).

Figure 2 shows similar streaking in the soft tissue around lungs in a CBCT taken during normal breathing. As with the single slice option on the simulator, there seem to be problems with the HU values both in accuracy compared with the calibration and reproducibility on a day-to-day basis. Slice thicknesses of 1–5 mm are available. Reconstruction times vary with the slice thickness and are in the order of 90 s. There is no standard way of quoting doses for these scans. Computed tomography dose index ($CTDI_w$) is a measure of the dose from a CT scan, weighted between the centre and the surface to give an average value across the section. A $CTDI_w$/810 mAs value of 15 mGy has been measured for a 10 cm scan length collimated to 13.8 cm (15 pulse s^{-1}, pulse length 15 ms, 80 mA, 125 kV, 45 s rotation). Setting the scan length to 1 cm in clinical mode gave 54 mGy/810 mAs with the same exposure factors. This compares with the national reference dose of 20 mGy for a multislice scanner [20].

CT simulation

The alternative to using the simulator and CBCT to acquire a volume data set of the patient in the treatment position was to modify CT scanners to meet the needs of radiotherapy and add software to perform the simulation function.

With the rapid development of computer technology, enabling fast reconstruction of images in three dimensions, the true value of the enormous quantity of data acquired by a CT scanner and its use in radiotherapy planning was recognized.

The development of the concept of the beam's eye view (BEV) into the transmission image from CT scans that would result from any beam orientation paved the way to producing images from CT data that correspond to conventional simulator films [21–23]. These digitally reconstructed radiographs (DRRs) could be overlaid with the outlines of anatomic structures, field shapes and cross wires, and hence could display images similar to simulator radiographs. However, the spatial resolution of DRRs is limited by the voxel size of the CT scans and cannot match that of a simulator radiograph taken with a small focal spot and a short exposure. Even in the early implementation of this process the reconstruction time of the DRRs was reasonable, being in the region of 10 s for a 50 slice study. However, studies were limited by the specification of the CT scanner. The acquisition of a single slice might take 2–3 s with a delay between scans required for repositioning of the scanner and tubes with low heat capacity needed cooling time during the scan [24].

Early critical analysis of the CT simulation process highlighted the areas for improvement [25]. These included the limitations imposed on both treatment technique and the size of the patient by the aperture of the scanner (normally 70 cm), the time required for CT data acquisition and transfer from the scanner to the planning system, time required for outlining and contouring target volume and critical structures and the inconsistent accuracy of portal marking on the patient's skin. Complete field ports were marked on the patient's skin in most cases and novel devices for doing this constituted an important part of the virtual simulation process reported. [26, 27]. These drawbacks have now largely been overcome.

Multislice helical scanning, with high heat capacity CT tubes, has reduced the time required to acquire a CT data set of 100 slices to a matter of seconds. Wide bore scanners have removed most of the constraints of patient size and technique. Increased computing capacity and speed allows for real time reconstruction of the slice images at the scanner and real time manipulation of images in the virtual simulation software. In addition, the DICOM protocol facilitates fast transfer of image data between systems.

Current practice

Conformal radiotherapy (CRT) is now accepted best practice for a number of treatment sites, having the advantages of sparing normal tissue and providing the opportunity for dose escalation. Intensity-modulated radiotherapy (IMRT) is the ultimate expression of this, but successful implementation of CRT and IMRT cannot be achieved without three-dimensional information on the location and extent of the target volume and the position of adjacent organs at risk (OAR). The three-dimensionality of virtual simulation is essential to visualize the coverage of the target volume and the avoidance of OARs in the highly complex treatment plans required for CRT and IMRT. For some sites, such as the lung where the relative position of the target and OARs varies with time, this fourth dimension needs to be taken into account.

Sherouse et al [28] introduced the term virtual simulation in 1987 to describe the process of using computer aided design and digitally reconstructed radiographs to replace the process of physical simulation. The process of virtual simulation has been described in detail by Aird and Conway [29] who also gave examples of its application to a number of different sites.

The specification of a CT simulator

The fundamental requirements of a CT simulator are a CT scanner with a flat couch, positioning lasers and virtual simulation software.

CT scanner

Advances in the design and capabilities of CT scanners have modified the specifications given by Aird and Conway [29]. Multislice scanners enable very fast scanning times, even for the large studies, with narrow slice thicknesses required for the production of good DRRs. High heat capacity anodes are required for the large datasets that are frequently required for treatment planning applications. One manufacturer (Siemens Medical, Erlangen, Germany) has introduced a new design of directly cooled anode that should eliminate delays due to anode heating and enable fast acquisition of scans with the large number of narrow slices required for good DRRs.

Three manufacturers now produce wide aperture (85 cm) scanners designed for radiotherapy applications. In two, the scanned field of view (SFOV) is 60 cm with an extended reconstructed FOV of 85 cm. It should be noted that in the extended reconstructed FOV the HU numbers may not be consistent with the SFOV. In reality, it is unlikely that the uncertainty in HU translates into a dose discrepancy of more that 1–2% in the target. The third manufacturer claims a true SFOV of 85 cm.

Positioning lasers

A system of three lasers for the accurate positioning and alignment of the patient is required. The lateral lasers may be wall or frame mounted, and may be either fixed or move in a vertical plane. The sagittal laser must be able to move laterally to account for lack of lateral movement on the CT couch. These lasers move under computer control to define the isocentre for the treatment plan in terms of shifts from the reference marks.

Virtual simulation software

The virtual simulation software may either be part of a treatment planning system or may be a stand-alone system. If the latter is chosen, it is essential that connectivity is easily established with the treatment planning system for dose calculation. Since the introduction of DICOM-RT this connectivity is more readily achievable, but the user must be aware that not all manufacturers interpret the standard in the same way and there are frequently hidden licensing issues associated with the connectivity. Essential features of virtual simulation software include automatic contouring of body outlines and semi-automatic contouring of other structures and critical organs such as spinal cord, kidneys and lungs. Particular attention should be paid to treatment of bifurcating structures. Contouring tools should be simple to use and interpolation between non-adjacent slices, with correction as necessary, should be provided to speed the contouring process. The ability to contour in three dimensions, *i.e.* in sagittal and coronal as well as axial sections, is particularly helpful. Figure 3 shows how three single contours in orthogonal planes produce a three dimensional structure. This functionality can considerably reduce the time taken to outline structures. The shape of the contours can be modified on any slice as necessary. Similar interpolation tools should be available for target volume delineation and true three-dimensional volume margin growth with different margin widths in different directions. Three-dimensional display systems are an essential feature of

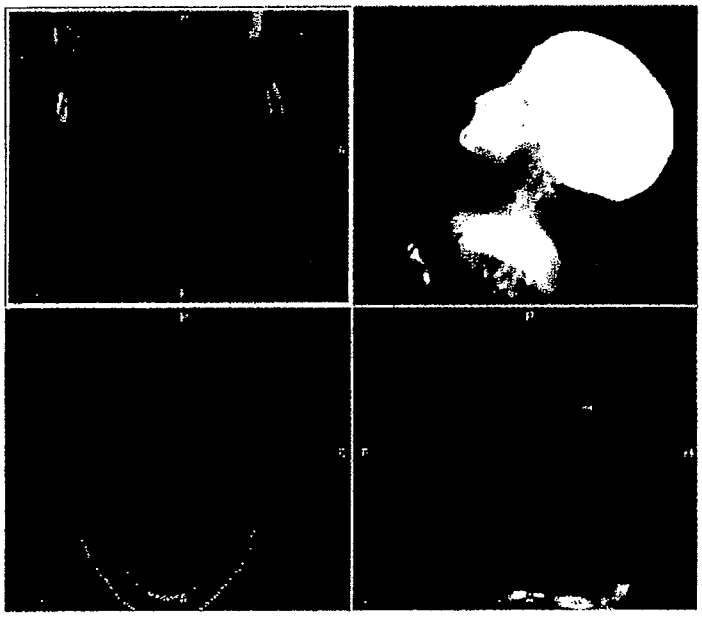


Figure 3. A single contour in axial sagittal and coronal planes defines a three dimensional target in Prosoma. (Courtesy of Oncology Systems Limited, Shrewsbury, UK and Medcom, Darmstadt, Germany).

any virtual simulation software. It should be possible to display axial, sagittal and coronal sections on the same screen and relate each section to the others, and to visualize the DRRs in the same window. An Observer's Eye View, with the patient on the couch and the floor and gantry angles depicted, is an aid to patient setup, as is a light-field displayed on the patient's skin related to skin marks or tattoos. Anti-collision software avoids planning a treatment field which it is physically impossible to reproduce in the treatment room. There are many different ways of rendering the target volume and OARs, but they should be unambiguous and should be rendered in three-dimensions so that coverage can be checked from all aspects. Optimization of MLC leaf positions and collimator angle should be available but adjustable by the planner. For treatment planning where a full dose distribution will not be calculated, a particularly useful feature is the calculation of the equivalent square of an irregular field, the parameter required for simple dose calculations. Increasingly, oncologists are using a number of other imaging modalities such as MRI (see Khoo and Joon in this issue) and positron emission tomography (PET) (see Jarritt et al in this issue) to help in determining target volumes. Most virtual simulation packages include an image fusion function enabling registration of two datasets of the same or different modalities, CT/CT, CT/MRI, CT/PET. Image registration and fusion may be achieved in a number of different ways, both manual and automatic (see Kessler in this issue). Irrespective of the algorithm, there is a variety of display modes to assist in performing and viewing the fusion, some of which are shown in Figure 4. Figure 4a shows the two data sets (MR and CT) fused with information from both sets displayed in the same window. The image can be "faded" between the two showing 100% of the primary data set (CT in this case) through to 100% of the secondary data set (MRI in this example). Figure 4b shows a split screen, with two quadrants displaying the CT data and two showing the MRI data. The point of intersection can be moved around the image to display the intersection at any position on the image. This will assist in delineating the structures using information from both data sets. Figure 4c shows a split screen with the secondary data set fused with the primary in the centre of the image and the primary image on either side. Contours outlining the target or OARs can be drawn on either data set or on the fused images in any of these display modes. These three screens show the fused images in the top three windows and the secondary data set in the lower windows. Figure 4d shows the region of discrepancy between the two fused data sets, in this case two CT studies, as areas of enhancement on the image. Improved localization of a brain tumour when CT and MRI data sets are fused compared with localization on CT alone for treatment planning is demonstrated in Figure 5.

Comparison of conventional and virtual simulation

Conventional and virtual simulation approach the task of localizing the target volume for treatment planning in very different ways, which may result in significantly different treatments. Realisation of the steps performed to provide the data to a treatment planning system is compared for the two modalities in Table 1.

In comparing the two methods of simulation, the first question that arises is whether the two are comparable in terms of accuracy of the treatment set up. There are a number of studies addressing this question for different treatment sites. Bollet et al [30] showed that in a series of 20 patients who were CT scanned and had conventional simulation, the precision of set up evaluations using DRRs was similar to that using simulator films in conformal prostate treatments. They also considered whether errors were introduced at the simulation stage and found a statistically significant systematic error between DRRs and simulator, in both the craniocaudal direction and the anteroposterior direction. In another study of prostate patients Valicenti et al [31] showed that there was no statistically significant reduction in treatment setup error if patients have physical simulation following virtual simulation and concluded that physical simulation may be omitted if virtual simulation is available. In a study of 86 patients undergoing palliative radiotherapy for lung cancer using parallel opposed fields, McJury et al [32] found that setup errors were comparable between the group planned by virtual simulation and that planned using conventional simulation. Similar results are reported at different treatment sites [33–35]. In a detailed study of setup errors in 39 patients undergoing CT planned radiotherapy for lung cancer, de Boer et al [36] concluded that the setup errors introduced at simulation, which become systematic errors if the simulator film is used as the reference image, were comparable with systematic errors at the treatment unit. Hence, omission of the simulation stage would reduce systematic errors on treatment. This conclusion supported a similar result for prostate patients [37].

In comparing the two methods of simulation, studies have shown that the target volumes and field sizes are smaller for virtual than conventional simulation in lung cancer with the associated reduction in irradiation of normal tissue [32, 38]. Smaller field sizes have also been reported for maxillary cancer with a corresponding reduction in long-term side effects [39].

One of the perceived advantages of virtual simulation is the improved coverage of the gross tumour volume (GTV) and the avoidance of OARs as a result of better visualization of soft tissue structures on a CT scan compared with a simulator image, particularly if shielded by bone. This is aided by software functions that remove overlying structures, giving better definition of the region of interest. A study comparing conventional and virtual simulation in the treatment planning of malignant lymphoma showed incomplete coverage of the spleen and spleen hilus in 5 of 15 and 6 of 15 patients, respectively, on conventional simulation and incomplete coverage of the right and left hilus in 4 of 15 and 1 of 15 patients, respectively. In addition, the left kidney was inadequately shielded in 6 of 15 of the conventionally planned patients [40]. Similar improvements in target coverage and OAR avoidance are reported for other anatomical sites [41–44].

Improved visualization of soft tissue structures may bring to light hitherto unsuspected pathology. Mehta

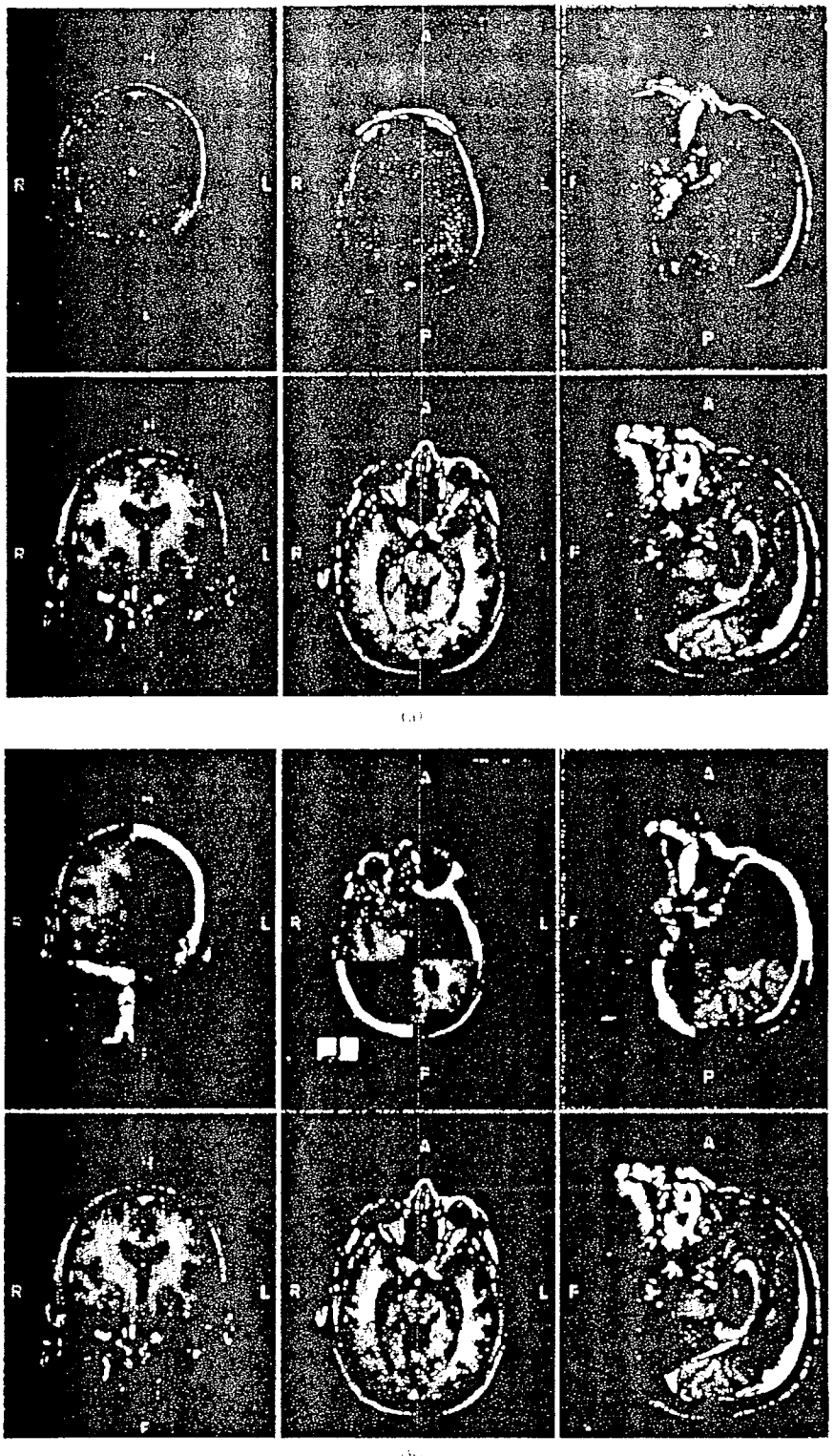
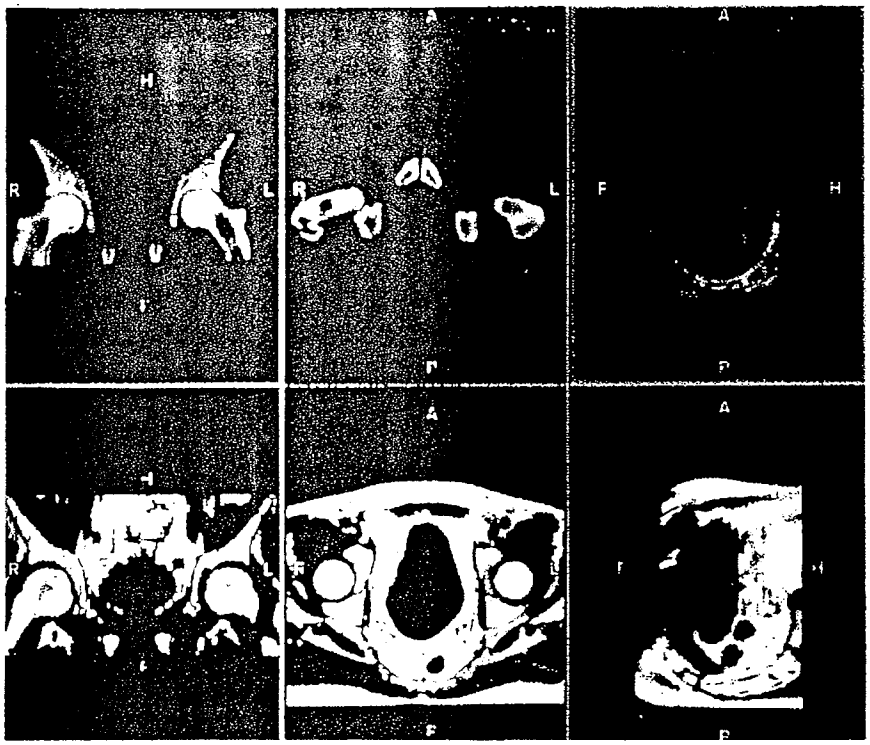


Figure 4. (a) Fusion of MRI and CT data sets. Fused images in the top windows and MR images below. (b) A split screen showing fusion between CT and MRI data sets in quadrants. (*Continued*)



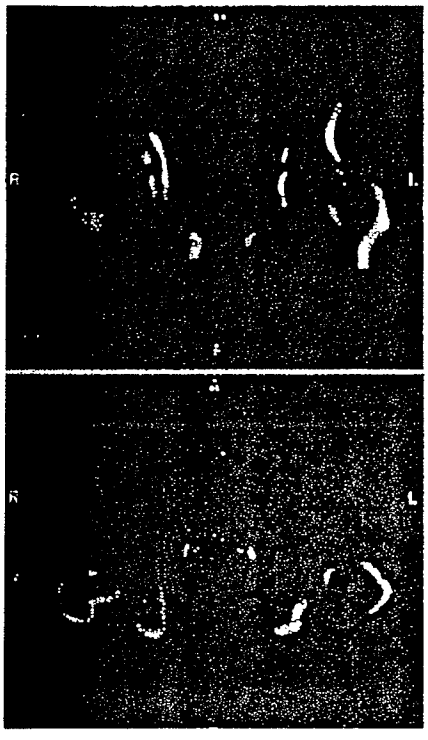


Figure 4. (*Cont.*) (c) An alternative split screen representation of fusion between CT and MRI data sets. (d) Areas of mismatch between two CT data sets displayed as image enhancement. (Courtesy of OSL and Medcom).

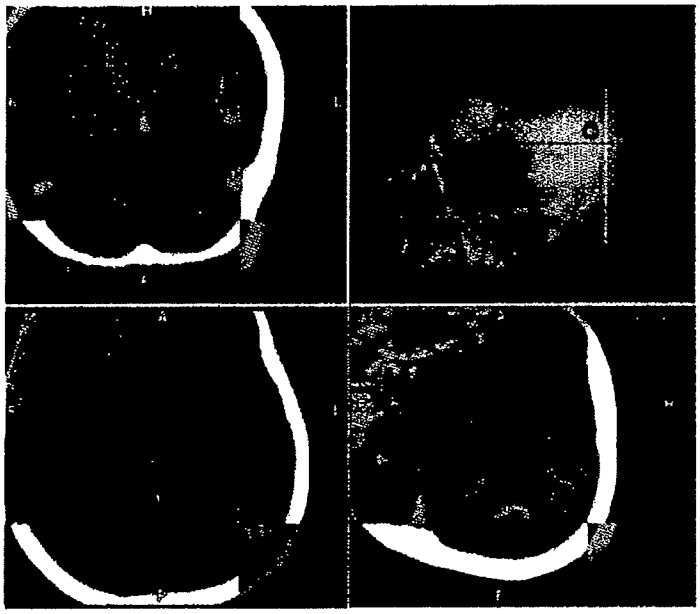


Figure 5. Improved localization of brain tumour using fused CT and MRI data sets. (Courtesy of OSL and Medcom).

and Goffinet [45] reported 17 unsuspected abnormalities in 153 scans (11%) obtained for treatment planning for patients referred for irradiation of the breast or chest wall. Of these, four represented disease that altered the treatment plan.

Working practices

The introduction of CT simulation has had a considerable impact on working practices in radiotherapy departments.

Oncologist attendance

The most notable change is that an oncologist is not required to be present during the scanning process. This releases the planning schedule from reliance on the oncologist's timetable, and the oncologists are free to undertake volume definition at a time convenient to them.

Time

A number of centres have reported on the different time allocation between conventional and virtual simulation [25, 28, 35]. Experience at the Kent Oncology Centre has shown that there is little difference in the total time needed for localization between the two modalities for the planning radiographers. With three radiographers in the scanning suite, 20 min appointments are adequate for most patients. Patients undergoing planning for breast radiotherapy are usually allocated 30 min because of the complex immobilization and positioning required with a narrow aperture scanner. These times are shorter than conventional simulation (30 min and 45 min, respectively), but more time is spent in manipulating the acquired data in the virtual simulation software. This includes the registering of reference marks and the production of DRRs for palliative patients, and outlining of target volumes and OARs for radical patients. Reduced simulation time for the patient leads to improved patient compliance, resulting in fewer problems from movement during scanning.

Table 1. Comparison of localization with CT and conventional simulation

Function	Conventional simulation	Virtual simulation
Patient alignment	Room lasers	Room lasers
Reference point definition	Skin markers	Skin markers
Localization	Fluoroscopy	CT scan
Definition of target and organs at risk	Drawing on plane films	Contouring on original or reconstructed slices
Isocentre	From simulator scales or film	DRR from CT
Field definition	From simulator scales or film	Virtual Sim
Patient outline	Manual/optical/single slice on Sim CT	Axial slice
Isocentre compared with reference point	Shifts measured on film	Calculated from Virtual Sim data
Treatment verification	Plane films	DRRs

DRR, digitally reconstructed radiograph.

Reference marks

In conventional simulation, using fluoroscopy for localization of the target volume, the isocentre can usually be established and marked at the time of simulation. In CT simulation, a reference point is chosen at the scanning session and the eventual isocentre is defined by movements of the couch from the reference point. If virtual simulation of palliative patients is undertaken with the patient remaining on the couch, the isocentre can be marked immediately from the couch movements indicated.

Verification

It has already been shown that to verify a plan on a conventional simulator after virtual simulation is not only unnecessary, but it could also be a source of systematic errors. However, treatment verification is still required and is of greater importance because of the use of reference marks. Verification takes place on the treatment unit with the electronic portal imaging system. The portal images acquired are then compared with the DRRs produced by the TPS or the virtual simulation software. For complex plans, this may require an extra treatment slot to allow time for the detailed comparison of portal images and DRRs before treatment.

Advantages and disadvantages of conventional and CT simulation

The advantages and disadvantages of conventional and CT simulation are summarized in Tables 2 and 3.

The availability of a three-dimensional dataset for all patients has some unexpected benefits. The increased information available may demonstrate previously unsuspected disease that may influence patient management. In palliative patients the extent of bone destruction from osteolytic lesions is easier to visualize on a CT scan than on a simulator film (Figure 6) and the use of software functions to remove overlying structures and display images optimized for different tissue types enables quicker localization of the disease. In breast planning, cardiac and lung volumes are more clearly demonstrated and therefore the fields can be adjusted or shielding employed accordingly.

One disadvantage of CT simulation is the increased patient dose. Doses for CT scanners are quoted as $CTDI_w$ with values in the region of 20 mGy. This dose is delivered to regions of normal healthy tissue as well as the tumour volume. Manufacturers of CT scanners provide various methods to reduce the total dose to the patient, taking account of the different dimensions of the patient at different levels and modulating the exposure in response to the detector measurements.

Some challenges still remain. Respiratory motion can affect the position of lung tumours and their relationship to OARs. Fast scanning protocols freeze patient and organ motion giving a snapshot view in time and space which may lead to inaccuracy in target delineation and choice of margins in three dimensions. Imaging techniques to overcome this drawback are an area of active investigation. The conventional method of treatment planning for lung tumours is to use fluoroscopic imaging to determine the maximum migration of the tumour during respiration and adopt large margins around the CTV to ensure that the target remains in the high dose region throughout the breathing cycle. A similar philosophy can be adopted by performing scans at deep inhale and deep exhale [46]. However, a number of other techniques have been suggested involving breath holding and respiratory gating techniques [47]. Deep inspiration breath hold (DIBH) increases the lung volume relative to normal breathing and hence the total volume of lung irradiated will be reduced using this technique [48]. In some patients, DIBH may displace the tumour away from OARs [49], which has the potential for dose escalation to the target for the same level of toxicity to OARs. Gated respiration techniques may either be active or passive. In active breathing control (ABC), the patient is prevented from breathing at a given part of the respiratory cycle during which the scan is performed and subsequent treatment takes place. By acquiring a number of scans at different parts of the breathing cycle, motion of the organ in three-dimensions can be demonstrated. Passive techniques allow the patient to breathe normally and a surrogate for the respiratory induced motion, such as the movement of the anterior chest wall, is monitored. Images obtained from CT scans are sorted according to respiratory phase to produce a 4D CT data set [50–52].

Table 2. Advantages and disadvantages of CT simulation

Advantages	Disadvantages
Three-dimensional dataset available, resulting in better visualization of tumour and nodal involvement, leads to reduction in side effects	Organ motion not visualized
Reduced simulation time leads to improved patient compliance	Repeat scan required for changes in patient set-up/shape/size during treatment
One fewer patient visit during planning	Palliative patients may spend longer in department between scanning and treatment
Oncologist not required during scanning	Transfer of verification to treatment unit may require extra treatment slot
Reduced transfer inaccuracies by omitting conventional simulator verification	Some patients/techniques may not be suitable for small aperture scanners (availability of wide aperture scanners should eliminate this problem)
Can simulate non-coplanar fields	Data storage
	Higher patient doses

Table 3. Advantages and disadvantages of conventional simulation

Advantages	Disadvantages
Fluoroscopy gives idea of organ motion	Difficult to visualize some tumours, especially if overlaid by bone (e.g. mediastinal lesions)
High spatial resolution	Limited three-dimensional information, even with CT option. Therefore cannot plan conformal or IMRT (cone beam may improve this)
Field visualization on patients skin	Two patient appointments required, localization and verification
	Difficult or impossible to simulate non-coplanar treatment fields

IMRT, intensity-modulated radiotherapy.

Breath hold and ABC techniques both require the co-operation of the patient and are therefore not appropriate for all patients. Some verbal or visual coaching helps to maintain regular breathing.

An alternative approach to the problem of organ motion is suggested by Murphy [53] who describes the real-time tracking of moving organs. Tracking respiratory motion is a complex procedure as it involves fast movement of organs relative to each other. For real-time tracking to be successful, the system must be able to locate the target, predict the motion to account for any time delays in repositioning the beam and adapt the treatment plan to allow for the change in relative positions of target and OARs. Although respiratory motion appears fairly regular, there are changes in amplitude and period from one cycle to the next which make prediction complicated. Murphy discusses two ways of predicting respiratory movement, by developing a mathematical model and by using an empirical algorithm that is based on measurements of previous breathing cycles. The technical challenges of fast response times to organ motion in continuous real time tracking are presented, but Murphy suggests that in the future it should be possible to treat lung tumours in some patients during free breathing, without needing to include movement margins in the treatment plan.

Respiratory correlation techniques developed to minimize motion artefacts in axial and helical scanning are not applicable to CBCT and different techniques have been developed for the CB application. Sonke et al [54] describe a method for sorting the projections into different phases of the breathing cycle to produce a 4D CBCT scan. Sillanpaa et al describe a method of acquiring megavoltage cone beam CT projection images at the same phase of breathing at all acquisition angles, giving a three-dimensional reconstruction at a single breathing phase [55]. It must be emphasised that gated respiration techniques must be employed at both the localization stage and during treatment.

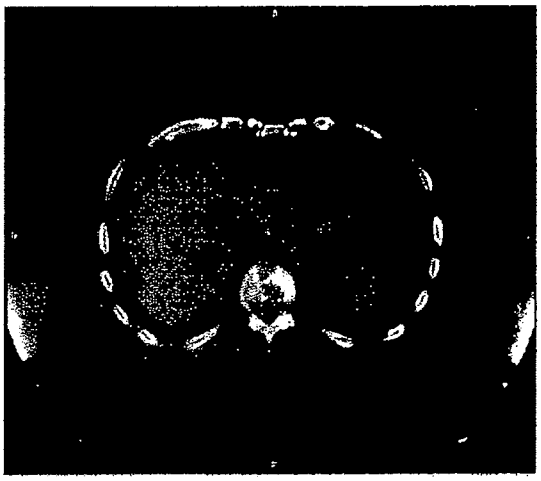


Figure 6. Osteolytic lesion of the spine.

Quality assurance

The accuracy of both conventional and CT simulation has a crucial effect on the overall accuracy of the patient's treatment. Whereas the accuracy of conventional simulation relies mainly on geometric features such as gantry and collimator angles and field defining wire positions, that of CT simulation depends on the image obtained by the scanner and the faithful transfer to the virtual simulation software. This connectivity should be part of any quality assurance (QA) programme.

A detailed description of quality control tests in conventional simulation and their recommended frequency is given by Tuohy [56].

Virtual simulation forms part of the network of the radiotherapy department, the end result of which is the treatment of the patient. The QA of this network should be seen as a process to which the various components of the hardware and software contribute. Guidance for the QA of a networked radiotherapy department is due to be published soon [57]. A QA programme should be established that reflects the importance of the contribution of each component of the system to the accuracy of the patient's treatment. Some components will be checked daily, such as the alignment of the lasers, the accuracy of positioning of any moving lasers and the HU accuracy for water. Others may be checked monthly, annually or after significant upgrades to the system. Special phantoms have been designed to assist with various aspects of QA [58, 59]. The Kent Oncology Centre has produced its own phantom that incorporates checks for a number of parameters in one scan study. These include spatial resolution, HU number, slice thickness, alignment and geometric accuracy.

Mutic et al [60] provide a comprehensive guide to the QA of CT simulators. They stress the need for audit and review of the process and flexibility in the programme as CT simulation evolves.

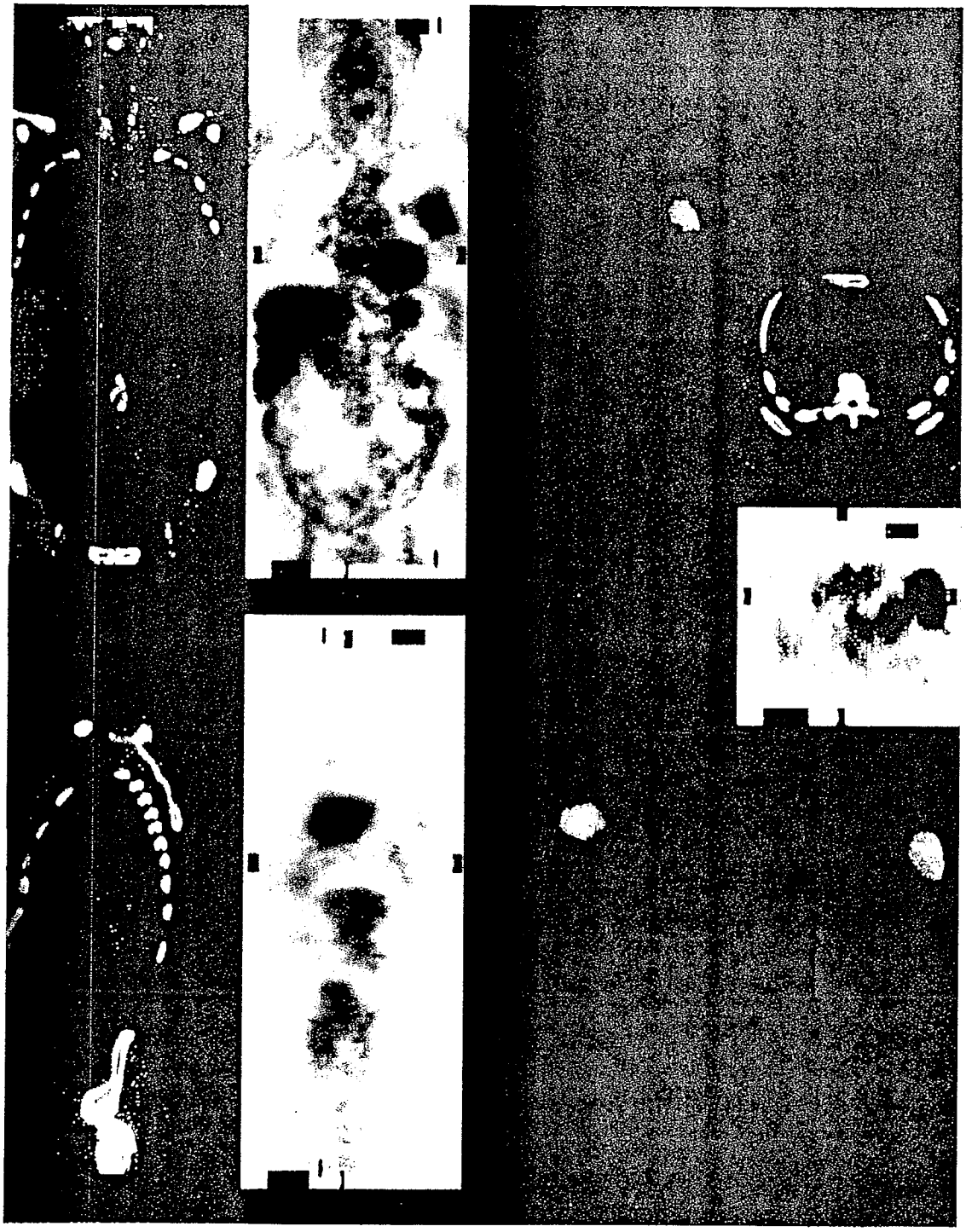


Figure 7. Fusion of positron emission tomography (PET) and CT images from a CT-PET scanner to visualize a left lung tumour

The future

The aim of radiotherapy is to deliver a tumoricidal dose of radiation to the clinical target volume (CTV) whilst sparing normal tissue and critical organs as far as possible. Localization is aimed at answering the question "where is the target?" The gross tumour volume (GTV) is neither a simple line nor an unchanging volume. It is an oncological concept and will vary according to the imaging technique or techniques used, any additional clinical data available and the judgement of the clinician. Each imaging modality displays different information about the GTV. Traditionally, delineation of the GTV has been associated with an anatomical abnormality that is imaged by plane radiography, CT or in some cases MRI. This gives structural, not functional information. However, molecular and physiological imaging techniques are now available which give an indication of the functional state of the tissues. This information can potentially be used in addition to CT and MRI to assist in defining clinically relevant targets more accurately [61]. Ling et al [62] proposed treating a biological target volume defined from anatomical, physiological and/or molecular images. For example, increased glycolysis is a function of a tumour and fluorine-18 fluorodeoxyglucose positron emission tomography (^{18}FDG-PET) studies have been used as an addition to CT for planning patients with poorly defined non-small cell lung cancer (NSCLC) [63, 64], head and neck cancers [65] and malignant gliomas [66] (see Jarritt et al in this issue). Figure 7 shows the fused images from ^{18}FDG-PET and CT acquired in a single session on a PET/CT scanner. The lesion in the left lung is clearly demonstrated in both modalities in this example. Other PET agents may be used to identify areas of hypoxia within a tumour that may benefit from higher doses of radiation such as can be delivered by IMRT. Similar inhomogeneous dose distributions may be applied to regions of the prostate demonstrating a high choline:citrate ratio, indicating a region of active tumour, as demonstrated on MR spectroscopy [67] (see Payne and Leach in this issue). Modalities such as functional MRI (fMRI) and single photon emission computed tomography (SPECT) may also be used to assist in GTV and OAR delineation. SPECT perfusion studies for NSCLC can be used in treatment planning to provide information on normal lung tissue and help to reduce the volume of normal lung irradiated [68].

Imaging techniques are continually evolving and as they are refined they will reveal more information about the disease to be treated. Collaboration between radiologists and oncologists will be essential if the information contained within these new images is to be maximized for the benefit of the patient.

No consideration of the future of radiation therapy would be complete without mention of image guided radiotherapy (IGRT). IGRT aims to address the interfraction movement of tumours and their relationship to OARs. Of the linear accelerator manufacturers, both Elekta (Crawley, Sussex, UK) and Varian (Palo Alto, CA) provide kilovoltage cone beam CT (CBCT) on the gantry and Siemens (Erlangen, Germany) have installed a CT scanner on rails in the treatment room (see Moore et al and Thieke et al, respectively, in this issue).

These imaging devices provide the ability to localize the tumour immediately prior to treatment and to reposition the patient to correct for interfraction variation in tumour position. Wong et al [69] describe the use of daily scans in the treatment room to reposition prostate patients for the final phase of their treatment. 46% required no isocentre adjustment in the anterior–posterior direction, but 44% required a shift of greater than 5 mm. In the superoinferior direction, 25% required a shift greater than 5 mm and in left-right direction 24% required a shift greater than 5 mm. The shifts were associated with significant changes in the dosimetry. Other authors describe the implementation of CBCT for IGRT [54, 70, 71].

IGRT is a rapidly evolving field and will undoubtedly have implications for treatment planning.

Conclusion

Both conventional and virtual simulation have developed in line with the changes in imaging techniques over recent years. The anticipated advantages of virtual simulation have been realised to a great extent and have changed the work flow in treatment planning. The availability of wide bore scanners enables most treatment techniques to be imaged. Fast computer graphics that have reduced image reconstruction times enable the acquisition of large data sets that can be manipulated for respiratory correlated techniques. The rapid development of biological imaging holds the prospect of multimodality localization, which is already being realised for some disease sites such as lung and prostate. The addition of cone beam CT to conventional simulators may add flexibility to departments with both a scanner and a simulator. However localization is achieved, it must be considered as part of the overall process that leads to treatment. The accuracy of the data acquisition and transfer is vital to this process and a comprehensive QA programme is essential.

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ONCOLOGY. Vol. 9 No. 11
The Stephenson/Wiley Article Reviewed

Current Techniques in Three-Dimensional CT Simulation and Radiation Treatment Planning

By

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Stephenson and Wiley demonstrate that three-dimensional (3D) CT-based simulation is an improvement in the simulation process. The growing importance of CT in radiation oncology treatment planning has been discussed previously [1] and is further emphasized in this article. The advantages of geometric optimization in three dimensions for radiation therapy treatment planning also are described. These results are applicable to both 3D and two-dimensional (2D) dose planning, because the treatment team can visualize and delineate structures on axial or reconstructed CT planes in greater detail than is possible with conventional simulation projected radiographs.

Computed tomographic simulation represents the integration of highly accurate anatomic definition with the treatment field design of conventional simulation [2]. The patient is set up in treatment position, with immobilization and positioning devices in place. Modifications required for the limited geometry of the CT scanner opening are incorporated into the treatment set-up.

The superior density and spatial resolution of CT data clearly differentiate internal anatomic structures, which allows the physician to more accurately define prescription volumes according to external-beam standards [3]. The gross tumor volume represents the visible extent of tumor. The CT simulator presents distinct anatomic boundaries for improved gross tumor volume delineation.

Of equal significance is the ability of CT simulation to visualize structures for explicit interpretation of the clinical target volume. In conventional simulation, the probability of involvement and the location of anatomy to be included in the clinical target volume is usually referenced to bony landmarks on plain radiographs. The clinical target volume represents the demonstrated gross tumor volume plus direct local subclinical spread and suspected regional and distal areas of involvement, such as lymph nodes (and edema).

In conventional 2D simulation, the clinical target volume is typically defined as a fixed margin beyond the gross tumor volume, due to the lack of anatomic information in simulation films and the difficulty in reconciling other diagnostic data with these films. In CT simulation, the anatomy in which potential microscopic extensions or occult disease may reside is seen directly, equipping the physician with better tools to interpret the clinical target volume. This improves the ability to manage patients, especially in the treatment of occult disease, for which radiation therapy is very effective. In addition, software tools are available to expand or dilate the clinical target volume (not necessarily equally in all directions) into the planning target volume, which includes margins for patient set-up variation and target and organ motion.

Geometrically Optimal Treatment Plan

Once the gross tumor, clinical tumor, and planning target volumes and normal anatomic structures are drawn and the patient departs, the CT simulator allows the treatment team to select a geometrically optimal plan, in two or three dimensions, while visualizing defined volumes of interest (gross tumor volume, clinical target volume, and others) through virtual simulation. The authors refer to nonaxial planning as noncoplanar planning. This is also known as 2.5-dimensional (2.5D) treatment planning, or the ability to select and reconstruct an oblique anatomic plane that best conforms to the target volume and spares normal tissues. This can be contrasted with conventional 2D planning, which is done only in the axial anatomic plane, and with full 3D planning, in which beams can enter the patient from any physically achievable direction.

In nearly real-time, beams-eye-view digitally reconstructed radiographs (DRRs) are calculated as gantry angle, couch angle, and field size, and other parameters are manipulated. The target volumes and anatomy drawn by the physician are seen as projected contours in the DRR, making treatment field parameter selection more accurate and more efficient. In addition, as pointed out in this article, DRR views can be obtained for any beam and patient position, even when the projection plane is inside the patient (eg, brain vertex). The CT simulator also produces DRRs for use as reference images in special cases, such as repeat fixation stereotactic radiotherapy, for which conventional simulation films are not available.

After selection of the treatment parameters, the DRR serves as the therapy reference film. It is used to fabricate shielding devices and as a reference for verification of treatment set-up. The authors state that CT simulations with 2-mm thickness and 2-mm index provide the best DRR quality, but that acceptable DRRs can be obtained with larger settings.

A study of DRR image quality with both axial and spiral scanning techniques revealed that sufficient DRR quality is achieved even with spiral scans at 1.5 pitch and 3- or 4-mm thickness [4]. Technique selection not only decreased scan time but also allowed for simulation procedures utilizing timed contrast injections and anatomic maneuvers (eg, breath holding, swallowing). Scanning technique also affects the accuracy of anatomic and target contours, and thus, the accuracy of volumes generated in CT simulation for treatment planning. Volumes produced by contours from scans of varying axial parameters, as well as spiral techniques, were indistinguishable for typical-sized structures in radiation therapy.

Digital Nature of Data Advantageous

Another inherent advantage of CT simulation is the digital nature of the data, which facilitates direct and therefore accurate communication with treatment planning and calculation systems. This represents an improvement over the conventional contouring process, for which secondary data entry is necessary and therefore the probability of error is increased.

The authors describe the dose-volume histogram as one objective tool for comparing treatment plans. Whether planning in many-slice 2D, 2.5D, or 3D, scoring functions such as the dose-volume histogram are required to select the most appropriate solution. New tools based on radiation biology and tumor kinetics describe normal tissue complication probability and tumor control probablility and provide guidance for dose prescription and dose escalation. The 3D anatomic information inherent in CT simulation is a prerequisite for calculation of any treatment plan scoring function.

Other Applications in Oncology

The CT simulator has been exploited primarily in external-beam radiation therapy but may have other important applications in oncology therapy and follow-up. It may be used to relate dose and 3D anatomy in brachytherapy [5]. The ability to visualize and analyze 3D anatomy and dose distributions is not typically available in conventional sealed-source brachytherapy planning.

Computed tomographic simulation may also enhance combined-modality oncologic management, providing the means to define radiosensitive areas to be targeted or avoided. The ability to visualize medically or surgically treated volumes for radiation therapy planning could improve patient management in sequential or concomitant therapy. The CT simulator may be ideal for monitoring these and other volumetric and density characteristics throughout treatment.

The ability to combine or correlate other diagnostic imaging information (eg, MRI, PET), although difficult, is being integrated into the CT simulation process, allowing more detailed characterization of target and normal tissue volumes.

A Significant Step Forward

Computed tomographic simulation brings the power of 3D anatomic information into the hands of the treatment planning team. Stephenson and Wiley show specific and graphic examples of how this represents a significant step forward in visualization, target delineation, and beam definition in radiation therapy treatment planning, which has the potential to improve quality of care. It is clear that CT-based virtual simulation represents an improved approach for any dose planning system, and that it may provide the oncology team with new methods for enhancing the therapeutic ratio.

Jeffrey A. Stephenson, MD, and Albert L. Wiley, Jr., MD, PhD

1. Lichter AS, Lawrence TS: Recent advances in radiation oncology. N Engl J Med 332(6):371-379, 1995.

2. Perez CA, Purdy JA, Harms W, et al: Design of a fully integrated three-dimensional computed tomography simulator and preliminary clinical evaluation. Int J Radiat Oncol Biol Phys 30(4):887-897, 1994.

3. International Commission on Radiation Units Measurements: ICRU Report 50, Prescribing, Recording and Reporting Photon Beam Therapy. Bethesda, MD, 1993.

4. Fong W, Herman MG: A comparision of axial versus spiral scanning in the application of CT in radiation oncology. 37th Annual AAPM Meeting. Boston, MA. Med Phys 22(9):1549, 1995.

5. Mayer R, Fong W, Franel T, et al: CT-simulator based brachytherapy treatment planning system utilizing dose rate dependent average cell survival and dose volume histogram. Int J Radiat Oncol Biol Phys 32(S1):295, 1995.

Exhibit 4

Frank A. Corvino, President & CEO, Greenwich Hospital

Frank Corvino, who celebrated his 20th anniversary at Greenwich Hospital in 2008, has served as president and chief executive officer of Greenwich Hospital since 1991; and was senior vice president and chief operating officer from 1988 to 1991. In addition, he is executive vice president of the Yale New Haven Health System.

Under Corvino's 22-year leadership, the Hospital has experienced unprecedented growth, which includes the opening of the Helmsley Medical Building (1999) and the Olive and Thomas J. Watson Pavilion (2005). Together these buildings completely replaced the Greenwich Hospital that existed in 1996. The state-of-the-art facility has been hailed as a model of healing for future hospital designs. During this time Corvino led the Hospital in fund solicitation efforts that raised over $175 million from its communities.

He has spearheaded the introduction of several new clinical programs in the Fairfield County/Westchester County region, ranging from the Breast Care Center, Endoscopy Center to expanded maternity, pediatric and geriatric services, and the Center for Integrative Medicine.

Corvino is responsible for instituting an "enhanced service excellence culture" at the hospital. Under his stewardship, since 2000 Greenwich Hospital has consistently ranked among the top hospitals nationwide in patient satisfaction, according to Press, Ganey Associates, the country's leader in healthcare satisfaction measurement. Corvino's ability to work effectively with physicians, patients, trustees, advocacy groups, hospital staff and others has been instrumental in establishing Greenwich Hospital's reputation as the premier regional healthcare facility.

Prior to Greenwich, Corvino was an executive vice president at Our Lady of Mercy Medical Center in Bronx, N.Y., where he also held various other management positions. He received his undergraduate degree in Pharmacy at Fordham University and completed his graduate training at St. John's University.

Corvino has held adjunct faculty teaching positions at New York Medical College and St. John's University. He is active in community and professional organizations and currently serves on the boards of the Connecticut Hospital Association (CHA) ,Greenwich Emergency Medical Services (GEMS) and the Norwalk Community College Foundation.

He has been honored by several organizations including:

- St. John's University Alumni Outstanding Achievement Medal (1998)
- Greenwich Rotary Club "Citizen of the Year" (2001) for his commitment to enhancing the quality of medical care in the region.
- Malcolm T. MacEachern CEO Award from the Health Academy of the Public Relations Society of America (2004) for his demonstrated exemplary use of public relations to advance the hospital's organizational goals.
- Ellis Island Medal of Honor by the National Ethnic Coalition of Organizations (2006)
- Port Chester/Rye Brook, N.Y. Chamber of Commerce Community Leadership Award (2008)
- United Way of Greenwich Helen Alvord Award for Excellence in Humancare Services (2009)

Last fall he was honored by the Columbus Citizen's Foundation at its annual banquet in New York in recognition of his contributions to society as an Italian-American. Corvino and his wife, Maura, live in Greenwich. He has two grown children, Timothy and Aimee.

(updated 6/10)

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SUMMARY OF QUALIFICATIONS

Hospital executive with proven track record achieving operational improvements in a highly competitive environment. Career reflects twenty-five years of progressively responsible positions in all aspects of hospital operations, total quality management, budget and financial performance, strategic planning, policy analysis, program planning and implementation.

PROFESSIONAL EXPERIENCE

Executive Vice President - and Chief Operating Officer — **Greenwich Hospital** — **2003 – Present**
Greenwich, Connecticut (174 bed, community teaching hospital, $235 million budget, 1800 employees)

Senior Vice President - and Chief Operating Officer — **Greenwich Hospital** — **1993 - 2003**
Greenwich, Connecticut (160 bed, community teaching hospital, $190 million budget, 1450 employees)

Selected Accomplishments:

- **Reorganized hospital around five service lines; recruited and appointed program directors. Wrote program strategic plans, implementing strategic plans.**
- **Directed hospital re-engineering and redesign process designed to streamline major hospital systems and to significantly reduce hospital costs.**
- **Lead facility program planning effort to construct a 350,000 sq. ft. replacement facility valued at $110 million. Coordinated with finance, legal, zoning and planning.**
- **Supervised new hospital construction; directed activation/occupancy process; facilitated training of physicians, staff and volunteers.**
- **Directed entire equipment and furniture planning and procurement effort.**
- **Installed hospital productivity reporting system with benchmark standards in all operating departments; implemented variable staffing system.**
- **Directed efforts to write mission, vision, values, and goal statements in all operating departments; 650 employees participated in writing departmental mission, vision, values, and goal statements.**
- **Lead intervential cardiology program planning.**

1991-1993

Executive Vice President - and Chief Operating Officer — **Champlain Valley Physicians Hospital Medical Center, Plattsburgh, New York (420 beds, rural referral center, $66 million budget, 1,500 employees)**

Selected Accomplishments:

- **Developed strategic and operational plan to revitalize Human Resources function; introduced organizational development activities; recruited and appointed Vice President/Human Resources to provide organizational leadership; organized policy/ procedure writing process, and coordinated implementation of two first term union contracts.**

- **Directed planning and implementation of hospital-wide managerial/supervisory compensation system, pay practices clarified, and compensation policy and procedure written.**

- **Implemented hospital-wide team building effort involving nearly 140 department managers and supervisors; directed successful effort to write hospital mission, vision, and values statement linked with 45 department mission, vision, and values statements.**

- **Built total quality management infrastructure; established and currently implementing four quality management teams who are studying their customers' needs and wants, and what can be done to improve customer satisfaction.**

- **Organized and directed more than 30 departmental total improvement teams.**

- **Negotiated hospital based physician contracts that resulted in appropriate renewal terms while maintaining positive medical staff/administration relations.**

- **Established physician/administrative capital budget committee to review and recommend purchase of capital budget items.**

- **Initiated operating room and materials management study; currently implementing recommendations to consolidate instrument processing and integrate inventory controls.**

1981 - 1991

Vice President - The Valley Hospital, Ridgewood, New Jersey
(421 beds, $118 million budget, 2,200 employees)

1980 - 1981

Assistant Director - The Valley Hospital, Ridgewood, New Jersey

Selected Accomplishments:

- **Organized and managed installation of cardiac surgery/angioplasty program that completed nearly 400 cases in its first year of operation. Program implemented in 139 days.**

- **Directed planning process for new facilities valued in excess of $45 million; facilities occupied and functioning as planned, included OR, lab, radiology, and obstetrics.**

- **Planned and implemented four hospital joint ventures that opened a free standing magnetic resonance imaging center - $3.6 million capitalization accomplished through a SEC registered offering.**

- **Created and organized hospital/medical staff (MeSH) organization; recruited and enrolled 145 physicians representing 14 departments; organized MeSH sponsored preferred provider organization which is available to approximately 6,000 employees and dependents; $650,000 claims first year.**

- **Recruited and trained new managerial leadership; built management skills; developed managerial training programs, resolved chronic medical staff complaints; improved morale, and reduced turnover rates (14%).**

- Directed installation of hospital material management program (actual cost of supplies/admission decreased 1986 vs. 1985).

- Served on numerous administrative and trustee policy committees; staffed and worked with Committee Chairmen preparing committee agenda, strategy, etc.

- Extensive experience working with the medical staff; planned and implemented new medical programs; resolved medical staff concerns.

1975 - 1980

Assistant Vice President - Rhode Island Hospital, Providence, Rhode Island
(719 bed university teaching hospital, 4,000 employees, 250 residents, 60 full time M.D. faculty)

Selected Accomplishments:

- Planned construction of $25 million emergency trauma and operating room facility; wrote role and program specifications.

- Reorganized outpatient clinics into decentralized subsidiary corporation group practices and directed implementation of free standing ambulatory surgery program that serves more than 6,000 patients per year.

1970 - 1973

Staffing Coordinator - Methodist Hospital, St. Louis Park, Minnesota
(475 beds, suburban community hospital)

- Introduced a management engineering based patient classification nurse staffing program with documented savings of $220,000 in first year of operation.

EDUCATION

University of Minnesota, Minneapolis, Minnesota, Master of Hospital Administration - 1975
Administrative Residency, Mount Sinai Hospital, Minneapolis, Minnesota

Tabor College, Hillsboro, Kansas; Bachelor of Arts in Business Administration - 1970

PROFESSIONAL AND COMMUNITY AFFILIATIONS

Fellow - American College of Healthcare Executives

Past Board Member - Valley Health Services and MRI of Northern New Jersey

Past Chairman - Private Academy, Hawthorne, New Jersey

Faculty Member - St. Peter College & Providence College

PERSONAL

Married; 3 children. Date of birth: May 17, 1947

EUGENE J. COLUCCI

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EXPERIENCE

GREENWICH HOSPITAL 1989 to Present

Greenwich, Connecticut

CHIEF FINANCIAL OFFICER

Direct all areas of financial management for a 296-bed acute care facility. These include General Accounting, Budget, Reimbursement, Accounts Receivable, Credit, Collections, Admissions, Medical Records and Information Systems. Oversees a staff of 100 employees, including the hiring and supervision of management staff. Investigate, plan and monitor areas for new business development. Review investment strategies and develop long and short-term plans to maximize return on assets.

CHIEF FINANCIAL OFFICER/CONTROLLER 1985 to 1989

Direct all aspects of financial management for a 223-bed acute care facility. These include General Accounting, Medical Records, Purchasing, Budget, Reimbursement, Accounts Receivable, Credit, Collections, Admissions and Data Processing Departments. Oversee a staff of 120 employees, including the hiring and supervision of management staff. Investigate, plan and monitor areas for new business development. Review investment strategies and develop long and short-term plans to maximize return on assets.

TOUCHE ROSS & COMPANY 1981 to 1985

New York, New York

AUDIT MANAGER

Supervised financial audits of hospitals. Prepared analyses and reports utilizing various software packages on personal computers. Assisted clients in implemented procedures to ensure collection of detailed financial information.

NEW YORK CITY HEALTH AND HOSPITALS CORP. 1977 to 1981

New York, New York

ASSISTANT DIRECTOR OF REIMBURSEMENT

Coordinated reimbursement reports and third party audits for 18 hospitals and 5 SNFs. Initiated Medicare appeals for cost adjustments.

BLUE CROSS AND BLUE SHIELD 1976 to 1977

New York, New York

AUDITOR

Conducted Blue Cross, Medicaid and Medicare audits on the uniform financial reports.

EDUCATION

ST. JOHN'S UNIVERSITY, Jamaica, New York
M.B.A. - 1979

NIAGARA UNIVERSITY, Niagara Falls, New York
B.B.A. Accounting – 1976

CERTIFICATION

Certified Public Accountant, State of New York – 1984

AFFILIATIONS

American Institute of Certified Public Accountants
New York State Institute of Certified Public Accountants
Health Care financial Management Association

DOMENICO DELLI CARPINI

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Cancer Center
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EDUCATION

DABR	American Board of Radiology, 1995. Certified in Therapeutic Radiological Physics.
Post-Doc	Harvard Medical School, September, 1992 Joint Center for Radiation Therapy, Research Fellow in Radiation therapy
Ph.D.	(Physics) Boston University, May, 1990. Dissertation on "Elastic Photon Differential Cross Section for Helium Near the Delta Resonance."
M.Sc.	(Physics) Arizona State University, May, 1984. Thesis on "Low Energy Ion Bombardment on H_2O Ice."
B.Sc.	(Physics) Fordham University, May, 1980.

EMPLOYMENT HISTORY

1995-present : Chief Medical Physicist, Greenwich Hospital, Greenwich, CT.
1992-1994 : Medical Physicist, Norwalk Hospital, Norwalk, CT.
1990-1992 : Post-Doctoral Fellow, Harvard University, Cambridge, MA.
1985-1990 : Teaching and Research Fellow, Boston University, Boston, MA.
1984-1985 : H.S. Physics Instructor, Mary Louis Academy, New York, NY.
1980-1983 : Teaching and Research Assistant, Arizona State University, Tempe, AZ.
1981 : Research Scientist, Motorola, Inc., Phoenix, AZ.
1980 : Research Assistant, Argonne National Laboratory, Argonne, IL.
1978-1980 : Teaching Assistant, Fordham University, New York, NY.

PUBLICATIONS

1. "Development Of a statewide hospital plan for radiologic emergencies," N. Dainiak, D. Delli Carpini, M. Bohan, M. Werdmann, E. Wilds, A. Barlow, C. Beck, D. Cheng, N. Daly, P. Glazer, P. Mas, R. Nath, G. Piontek, K. Price, J. Albanese, K. Roberts, A. L. Salner, and S. Rockwell, Int. J. Radiation Oncology Biol. Phys., **65 No. 1,** 16-24 (2006).

2. "Photon scattering from ^{12}C and ^{4}He nuclei near the $\Delta(1232)$ resonance," R. Igarashi, J.C. Bergstrom, H.S. Caplan, K.G.E. Doss, E.L. Hallin, D.M. Skopik, D. Delli Carpini, E.C. Booth, E.K. McIntyre, J.P. Miller, M.A. Lucas, B.E. MacGibbon, A.M. Nathan, and D. Wells, Phys. Rev. C **52**, 755-763 (1995).

3. "Compton scattering from the proton," E.L. Hallin, D. Amendt, J.C. Bergstrom, H.S. Caplan, R. Igarashi, E.C. Booth, D. Delli Carpini, J.P. Miller, F.J. Federspiel, B.E. MacGibbon, and A.M. Nathan, Phys. Rev C **48**, 1497-1507 (1993).

4. "Nuclear Compton scattering from pion threshold to the delta," J.P. Miller, E.J. Austin, J. Bergstrom, H. Caplan, D. Delli Carpini, G. Dodson, M. Doss, E. Hallin, R. Igarashi, M.A. Lucas, E.K. McIntyre, A.M. Nathan, C. Rangacharyulu, D. Skopik, D. Warner, D.P. Wells, & D. Whitehouse, Nucl. Phys. A **546**, 199-211 (1992).

5. "Coherent Photon Scattering Cross Sections for Helium Near the Delta Resonance," D. Delli Carpini, E.C. Booth, J.P. Miller, R. Igarashi, J. Bergstrom, H. Caplan, M. Doss, E. Hallin, C. Rangacharyulu, D. Skopik, M.A. Lucas, A.M. Nathan, D.P. Wells, Phys. Rev. C **43**, 1525 (1991).

6. "Cross Section of the Reaction $^4He(\gamma,\gamma)^4He$ in the $\Delta(1232)$-Resonance Region," E.J. Austin, E.C. Booth, D. Delli Carpini, K.P. Gall, E.K. McIntyre, J.P. Miller, D. Warner, D.A. Whitehouse, G. Dodson, Phys. Rev. Lett. **61**, 1922 (1988).

7. "Sputtering of Ices by keV Ions," W. Christianson, D. Delli Carpini, I.S.T. Tsong, Nucl. Instru. and Meth. **15**, 218 (1986).

8. "Sputtering Yield of Titanium Carbide Under Helium Ion Bombardment," D. Delli Carpini, M. Kaminsky, Physics Division, Argonne National Laboratory Report, (1980).

PAPERS PRESENTED AT PROFESSIONAL CONFERENCES

1. "IMRT at a Community Hospital", D. Delli Carpini, J. Lo, R. Tupper, at Philips Radiation Oncology 10th Annual Oncology User's Symposium at ASTRO conference, Salt Lake City, Utah (2003).

2. "IMRT QA Verification Tests", D. Delli Carpini, J. Lo, R. Tupper, at Northeast Pinnacle IMRT Workshop, Teaneck, NJ (2003).

3. "Questions Concerning Radiation", D. Delli Carpini, at meeting of CT Society for Clinical Laboratory Science, Meriden, CT (2003).

4. "IMRT QA at a Community Hospital", D. Delli Carpini, J. Lo, R. Tupper, at RIT Users Group Meeting at ACMP conference, Lake George, NY (2003).

5. "What is IMRT? and Why do we need it?" D. Delli Carpini, J. Lo, R. Tupper, at CT Area Medical Physics Society meeting, Norwalk, CT (2003).

6. "Pinnacle ^{3} e IMRT con Varian," D. Delli Carpini, J. Lo , R. Tupper, at Pinnacle Users Meeting, Perugia, Italia, (2002).

7. "3D Treatment Planning at a Community Hospital", D. Delli Carpini, J. Lo, at the Fall Symposium of New England Chapter of Medical Physicists, Sturbridge, MA, (1998).

8. "Pinnacle Planning Experience in a Community Hospital Setting," D. Delli Carpini, J. Lo, at Pinnacle Users Group Meeting in New England, Springfield, MA, (1998).

9. "A Theoretical and Experimental Analysis of the Acoustic Field Patterns and S.A.R. Distributions from a Focused Segmented Ultrasound Machine," D. Delli Carpini, J.L. Hansen, G.K. Svensson, at the 6th International Congress on Hyperthermia Oncology, Tucson, AZ, (1992).

10. "Quality Assurance of a Spherical Focused Segmented Ultrasound Machine," J.L. Hansen, D. Delli Carpini, G. Martin, G.K. Svensson, at the 6th International Congress on Hyperthermia Oncology, Tucson, AZ, (1992).

11. "SAR and Temperature Distributions from a Spherical Focused Segmented Ultrasound Machine," G.K. Svensson, J.L. Hansen, D. Delli Carpini, B. Bornstein, T. Herman, F. Bowman, W. Newman, at the 6th International Congress on Hyperthermia Oncology, Tucson, AZ, (1992).

12. "Weakly Focused Ultrasound Applicator for Deep Hyperthermia," G.K. Svensson, B. Bronstein, D. Delli Carpini, J.L. Hansen, T. Herman, F. Bowman, W. Newman, E. Burdette, S. Gross, at the American Association of Physicists in Medicine Annual Meeting, San Francisco, CA, (1991). Med. Phys. **18**, 636 (1991).

13. "Compton Scattering on the Proton Near the Delta Resonance," D. Delli Carpini, E.C. Booth, J.P. Miller, D. Amendt, J. Bergstrom, H. Caplan, M. Doss, E. Hallin, R. Igarashi, D. Skopik, F.J. Federspiel, B. MacGibbon, A.M. Nathan, at the PANIC June meeting, Boston, MA, (1990).

14. "Elastic Photon Differential Cross Section for Helium Near the Delta Resonance," D. Delli Carpini, E. Booth, J. Miller, J. Bergstrom, H. Caplan, M. Doss, R. Igarashi, D. Skopik, M. Lucas, A. Nathan, D. Wells, at the American Physical Society Spring Meeting, Washington D.C., (1990). Bull. Am. Phys. Soc. **35**, 928 (1990).

15. "Elastic Photon Scattering from Helium in the $\Delta(1232)$ Energy Region," E.K. McIntyre, E.A. Austin, E.C. Booth, D. Delli Carpini, K.P. Gall, J.P. Miller, D. Warner, D.A. Whitehouse, G. Dodson, at the American Physical Society Spring Meeting, Baltimore, MD, (1988). Bull. Am. Phys. Soc., (1988).

HONORS and ACTIVITIES

Member of the American Association of Physicists in Medicine.
Member of the American Association of Physics Teachers.
Member of the American College of Radiology.
Member of the CT Association of Medical Physicists Society
Member of the Radiological and Medical Physics Society of NY.
2004-present Serving on Medical Physicist Workforce Subcommittee of AAPM
2004-present Serving on Professional Services Committee of AAPM

2003 Served on Ad Hoc Committee on Placement Services for AAPM
2002 President, CT Association of Medical Physicists Society
1999-present Serving as member of Professional Economics Committee of AAPM
1999-2004 Served as member of Professional & Public Relations Committee of AAPM
1998-2002 Served as Board Member of the American Association of Physicist in Medicine.
1997 President, CT Association of Medical Physicists Society
Teacher Excellence Award, Boston University, May, 1987.
Graduate Research Grant, Arizona State University, May, 1983.
Arizona Vacuum Society Scholarship, May, 1982.
Victor F. Hess Physics Award, Fordham University, May, 1980.

RALPH SGAMBATO
5 Mulberry Court
Cheshire, CT 06410

Home: (203)272-2056 Office: (203)863-3036

SUMMARY

Program Director for Oncology and Diagnostic Imaging Director

EXPERIENCE

1979 – Present

Greenwich Hospital
Yale New Haven Health
Perry Ridge Road
Greenwich, Connecticut

Program Director

Oncology and Diagnostic Imaging

Responsible for program planning, development, organizing and supervising the management and administrative systems for Oncology and Diagnostic Imaging activities. Direct the Bendheim Cancer Center, In-patient Oncology Unit, Diagnostic Imaging Department and the Breast Center with a staff of 110 in a medical center environment.

- **Program development: Radiosurgery in conjunction with Neurosurgery, Prostate Implantation Brachytherapy, Sentinel Node Breast Surgery Program, and current planning for a Prostate Care.**
- **Evaluated, recommended and prepared bid specifications for equipment which resulted in ability to provide state-of-the-art services and improved capabilities. (IMRT)**
- **Prepared Certificate-of-Need applications for Magnetic Resonance Imaging, Computerized Tomography and Linear Accelerator which facilitated the acquisition of new imaging/therapeutic systems.**
- **Conducted systems analysis within departments for improved patient throughput and enhanced customer relations.**
- **Conducted restructuring of task analysis and reassigned tasks for improved productivity.**
- **Introduced tele-imaging concepts within diagnostic imaging department to facilitate patient care and to maximize professional efficiency. In the process of PACS planning and implementing a $3.5 million dollar project.**

Administrative Director *March 1996 – 1998*

Department of Radiology, Radiation Oncology and Cardiology

Responsible for budgeting, coordinating staffing assignments, patient services, interdepartmental coordination, maintenance of all equipment, quality assurance, safety and implementing hospital/departmental policies and procedures.

Administrative Director *September 1979 – 1996*

Department of Radiology and Radiation Oncology

Responsible for budgeting, coordinating staffing assignments, patient services, interdepartmental coordination, maintenance of all equipment, quality assurance, safety and implementing hospital/departmental policies and procedures.

1977 – 1988 New York University

New York, New York

Staff Radiologic Technologist

Department of Radiology

Staff radiologic technologist performing general radiography, special procedures, cardiovascular special procedures and teaching in the School of Radiologic Technology.

EDUCATION

1975, Yale-New Haven Medical Center School of Radiologic Technology, New Haven, Connecticut with an ARRT and Associate Degree in Science.

1977, State University of New York, Brooklyn, New York with a Bachelor of Science Degree, Major in Radiologic Sciences and Management

1979, New York University, Graduate School of Public Administration, NY, NY with Masters in Health Administration

Licenses/Certificates

- **American Registry of Radiologic Technologists**
- **Connecticut State License – Radiographer**

Daniel Chamberlain, MD
310 Aspen Glen Drive
Hamden, CT 06518
(203) 448-6203
daniel.chamberlain@yale.edu

EDUCATION

2009-2010 **Chief Resident**
Yale Department of Therapeutic Radiology
Yale University School of Medicine/Yale New Haven Hospital
New Haven, Connecticut

2006-2010 **Radiation Oncology Residency**
Yale University School of Medicine/Yale New Haven Hospital
New Haven, Connecticut

2005-2006 **Medical/Surgical Transitional Year Internship**
Mayo Clinic Arizona
Scottsdale, Arizona

2001-2005 **Doctor of Medicine**
Columbia University College of Physicians and Surgeons
New York, New York

1994-2001 **Bachelor of Arts**
Major: History
Brigham Young University
Provo, Utah

EMPLOYMENT

2010-Present **Clinical Director of Radiation Oncology**
Greenwich Hospital
Greenwich, Connecticut

PROFESSIONAL DEVELOPMENT

2010 **BrainLab Academy Intracranial and spine radiosurgery course**
Westchester, Illinois

2009 **Breast Brachytherapy Elective Rotation**
Dr. Robert Kuske
Arizona Breast Cancer Specialists
Scottsdale, Arizona

2009 **Spine IGRT Elective Rotation**
Dr. Yoshiya Yamada
Memorial Sloan Kettering Cancer Center

New York, New York

2009 **ASTRO IGRT Symposium**
Miami, Florida

2009 **Breast Brachytherapy School**
American Brachytherapy Society
San Antonio, Texas

2008 **US-Guided Transperineal Brachytherapy for Early Stage Prostate Cancer**
Seattle Prostate Institute Resident's Course
Seattle, Washington

KEY SKILLS

IMRT for Head and Neck, Prostate, GYN, GI, and CNS
Linac-based Body Stereotactic Radiotherapy
IGRT using Calypso and Cone Beam CT
Brachytherapy for GYN, Breast and Prostate
Gamma-knife CNS Radiosurgery
Eclipse and Pinnacle treatment planning systems

HONORS AND AWARDS

2002 **Stanley Scholar Summer Research Fellowship**
Columbia University Division of Functional Brain Mapping

1998-2001 **Phi Kappa Phi,** Brigham Young University Honor Society
1998-2001 **Phi Alpha Theta,** History Honor Society

1995-2000 **National Merit Scholarship**

LEADERSHIP AND ADVOCACY

2009-present **Yale Graduate Medical Education Committee**
Resident Representative

2009 **ASTRO Advocacy Day**
Washington DC Participant

2004-2005 **Columbia University Medical School Dean's Curriculum Committee**
Class Representative

2001-2002 **American Medical Student Association Legislative Affairs Representative**
Columbia University Representative

PUBLICATIONS/PRESENTATIONS

Moran MS, Castrucci WA, Ahmad M, Song H, Lund MW, Mani S, **Chamberlain D,** Higgins SA. Clinical Utility of the Modified Segmental Boost Technique for Treatment

of the Pelvis and Inguinal Nodes. International Journal of Radiation Oncology Biology Physics 76:1026-36, 2010.

Chamberlain DD, BP Rowe, RH Decker. Simultaneous Treatment of Synchronous Primary Lung Cancers with Stereotactic Body Radiotherapy (SBRT). American Society of Radiation Oncology Annual Meeting, Chicago, Illinois; 2009. Poster Presentation.

Chamberlain D, Moran MS. Commentary Re: Taylor et. al. Estimating Cardiac Exposure from Breast Cancer radiotherapy in Clinical Practice. Breast Diseases: Breast Diseases: A Yearbook Quarterly. 20:448-449, 2009.

Chamberlain DD, Weidhaas JW. Clinical Outcomes Using a Dose Painting IMRT Technique Combined with a Single Low Dose Rate Implant Bulky, Locally Advanced Cervical Cancer. American Radium Society Annual Meeting, Vancouver, Canada; 2009. Poster Presentation.

Chamberlain DD, Moran MS. Commentary Re: Wong et. al. Tangential Radiotherapy Without Axillary Surgery in Early-Stage Breast Cancer: Results of a Prospective Trial. Breast Diseases: A Yearbook Quarterly 20:83-84, 2009.

Chamberlain DD, Yu JB, Roberts KB, Higgins SA, Mani S, Ozturk AK, Chiang V, Knisely JP. Detection of Occult Brain Metastasis with High Resolution MRI Using Double vs. Single Dose Gadolinium. American Society for Therapeutic Radiology and Oncology Annual Meeting, Boston, Massachusetts; 2008. Poster Presentation.

PROFESSIONAL MEMBERSHIPS

American Society for Therapeutic Radiology and Oncology
American Brachytherapy Society
American Medical Association
Association of Residents in Radiation Oncology
American Radium Society

ADDITIONAL LANGUAGES

Spanish

76 NEWTON STREET • FAIRFIELD, CT 06824
PHONE 203.521.9091
mmar919@optonline.net

MARIA P. MARINI RN, BSN, OCN

EDUCATION

RN	St. Vincent's College of Nursing	Bridgeport, CT
BSN	Sacred Heart University	Fairfield, CT

PROFESSIONAL EXPERIENCE

2007- Present **Greenwich Hospital**

Oncology Program Director

2006- 2007 **Bridgeport Hospital**
Cancer Program Specialist NFPCI Cancer Institute
Bridgeport, CT

- Oversight of Cancer Resource Center -
  - SOP's for Cancer Resource Center and in response to community inquiries
  - Volunteer staff - marketing, recruitment, orientation and supervision
  - Community and State agencies- served as liason with ACS, L&L, CancerCare, ALF, CT Cancer Coalition
  - Community Outreach planning- programming targeting lay and professional audiences including CME programming
  - Grant funding for specialty programming- proposal writing and application follow through
  - Speakers bureau (MD & RN) - development, scripting and training in response to community requests for educational programming
  - Bilingual (latino) cancer counseling and support service – created program in response to community served

2006 – 2007 **Bayer Pharmaceuticals**
Drug Safety Assurance West Haven, CT

- Receive and process spontaneous post marketed chemotherapy and clinical trial adverse event cases received from domestic, regional and Licensed Partner sources (GSK, Schering Plough, Alza, J&J)
- Re-evaluate the provisional FDA classification of each adverse event report and re-evaluate the classification of the case at each step of the process.
- Ensure the processing of adverse event reports and queries in a timely fashion as specified by Federal Regulations and departmental SOPs. This involves the analysis and classification of reports, data entry, coding of data, and clarification of questions with appropriate personnel, in-house circulation and organization of case files.

- Monitor the status of adverse event reports during in-house circulation.
- Work with other departments to ensure consistent, accurate and timely reporting of adverse event information.
- Ensure proper documentation in case files by the appropriate personnel regarding safety reporting decisions.

Reference inquiries to:

Dan Scarfo MD JD, Therapeutic Leader- Hematology

dan.scarfo@bayer.com

2004-2006 **Millennium Biotech Pharmaceuticals**

Oncology Specialist Cambridge, Massachusetts

- Responsible for ongoing education and support of Bortezomib (Velcade) for professional staff- MD, DO, RN, NP, Research Professionals in Oncologist Offices (192 professionals), Cancer Centers, Hospitals & Medical Centers in the White Plains territory from Milford, Connecticut extending to (and including) Bronx, NY, Westchester County and Danbury, Ct.
- Responsibilities:

  Development of quarterly strategic business plan, including budget distribution;

  Achievement of sale target goals ($3+million);

  Ongoing support and maintenance of strategic alliance with community

  Organizations (i.e. Multiple Myeloma Foundation. ACS, Leukemia and

  Lymphoma Society, 4 local chapters of ONS, and International Myeloma

  Foundation)

  Development and implementation of Physician and ancillary staff education

  programs based on clinical trial data, enlisting the support of Key opinion

  leaders including coordination of Tumor Boards, Grand Rounds;

  Identification and training of new 'key opinion leaders' in medical oncology

  Troubleshooting Medicare / Medicaid reimbursement issues;

  Overall support of pharmaceutical product (chemotherapy) usage.

Reference inquiries to "The Work Number"

http://www.theworknumber.com or 1.800.367.2884.

Millennium Employer Code 11415

1996–2004 **St. Vincent's Medical Center**

Oncology Nurse Manager Bridgeport, CT

- Responsible for the day-to-day operations and staffing of 22 bed Inpatient Adult Medical Inpatient Oncology Unit, Inpatient Hospice/Palliative Care Program, Outpatient Ambulatory Infusion Center (5,000+ visits/year), Radiation Therapy Nurse Clinician Program, and Oncology Clinical Trials Research Program.

- Coordination of Multidisciplinary Services including Case Managers (Inpatient and Community), Social Work, Dietary, Pastoral Care, PT/OT, Pain Management Service.
- Coordination of in home care of cancer patients- assessment, intervention, symptom management, education, triage for IP admissions
- Management of $3+million operating budget, including development of annual strategic plan of oncology services.
- Coordination of professional / non professional staff education and maintenance of JCAHO designated competencies; annual chemotherapy/ radiation/ hospice certification for 50+ employees.
- Coordination of American College of Surgeons (ACOS) Cancer Center application/ site review.
- Development and on-going revision of Oncology Nursing Policies for Inpatient, Outpatient, Hospice Program and Radiation Nursing.
- Coordination of community fund raising programs for Oncology Services (e.g. wigs, breast prosthesis)
- Coordination of distribution of Benefactor Funds/Community Resources to optimize patient outcomes.
- Coordination and oversight of Oncology Clinical Research Program.
- Development and implementation of on-going Oncology Performance Improvement Program.
- Responsible for Cancer Committee membership, monthly meetings and adherence to ACOS guidelines with Oncologists and ancillary staff.
- Physician Liaison for Community Medical Oncologists.
- Responsible for outpatient medical record coding, billing and reimbursement from 3rd party providers

Reference Inquiries to:

SVHS- Human Resources Department- Deborah Peck 203.576.5509
Dale Danowski - VP Patient Care Services 203.576.5760
Teri Ann Dray- Director 203.574.5488
Mary Alice Koleszar - Oncology Manager 203.576.5528

1993 – 1996 St. Vincent's Medical Center **Bridgeport, CT**
Charge Nurse, Ambulatory Infusion Center

1990 – 1996 Omicron Corporation **Bridgeport, CT**
RN Consultant to Cancer Screening Program

1985 – 1993 St. Vincent's Medical Center **Bridgeport, CT**
Charge Nurse, Ambulatory Center

1984 – 1993 Occupational Health Registry **Fairfield, CT**
Consultant to Industry Based Health Maintenance Programs

CERTIFICATIONS/PROFESSIONAL AFFILIATIONS

1991- Present
Oncology Nursing Society, National Member - ID#45924
1991 - Present
SWCONS Chapter 193 - Member
1996 – Present
OCN (Oncology Nursing Certification)
1990, 1992, 1994, 1996 – SVMC Distinguished Nurse Award
2002 – Present
ACOSOG (American College of Surgeons Oncology Group) Affiliate Member
2003- Present
CTSU (Clinical Trial Support Unit) Affiliate Member
2004 – ONS Foundation- Congress Scholarship Recipient for Achievement in Oncology Nursing Management
2007 –2008 President, Southwest CT Oncology Nursing Society Chapter 193
2008 -2009 Director at Large, Southwest CT Oncology Nursing Society, Chapter 193

RN Licensure: Connecticut E38443
Florida 9236206

1991- Present
Oncology Nursing Society, National Member - ID#45924
1991 - Present
SWCONS Chapter 193 - Member
1996 – Present
OCN (Oncology Nursing Certification)
1990, 1992, 1994, 1996 – SVMC Distinguished Nurse Award
2002 – Present
ACOSOG (American College of Surgeons Oncology Group) Affiliate Member
2003- Present
CTSU (Clinical Trial Support Unit) Affiliate Member
2004 – ONS Foundation- Congress Scholarship Recipient for Achievement in Oncology Nursing Management
2007 –2008 President, Southwest CT Oncology Nursing Society Chapter 193
2008 -2009 Director at Large, Southwest CT Oncology Nursing Society, Chapter 193

RN Licensure: Connecticut E38443
Florida 9236206

Exhibit 5

Internal Revenue Service

Date: October 4, 2007

GREENWICH HOSPITAL
% CHRIS CONNOR
5 PERRYRIDGE RD
GREENWICH CT 06830-4608

Department of the Treasury
P. O. Box 2508
Cincinnati, OH 45201

Person to Contact:
Mary Holland 17-57088
Customer Service Representative
Toll Free Telephone Number:
877-829-5500
Federal Identification Number:
06-0646659

Dear Sir or Madam:

This is in response to your request of October 4, 2007, regarding your organization's tax-exempt status.

In February 1972 we issued a determination letter that recognized your organization as exempt from federal income tax. Our records indicate that your organization is currently exempt under section 501(c)(3) of the Internal Revenue Code.

Our records indicate that your organization is also classified as a public charity under sections 509(a)(1) and 170(b)(1)(A)(vi) of the Internal Revenue Code.

Our records indicate that contributions to your organization are deductible under section 170 of the Code, and that you are qualified to receive tax deductible bequests, devises, transfers or gifts under section 2055, 2106 or 2522 of the Internal Revenue Code.

If you have any questions, please call us at the telephone number shown in the heading of this letter.

Sincerely,

Michele M. Sullivan

Michele M. Sullivan, Oper. Mgr.
Accounts Management Operations 1

000175 NOV 1 10

STATE OF CONNECTICUT
DEPARTMENT OF REVENUE SERVICES
92 Farmington Avenue, Hartford, CT 06105

TAX EXEMPTION PERMIT ISSUED UNDER THE SALES AND USE TAXES ACT

In accordance with the provisions of the Sales and Use Taxes Act and the regulations thereunder, it is hereby certified that the charitable or religious organization named below is exempt from all sales and use taxes on purchases of tangible personal property made by it for the sole and exclusive purposes of the organizations.

Duplicate

Permit No. E.-0933

Date Issued 4/18/91

The Greenwich Hospital Association
Perryridge Road
Greenwich, CT 06830-4697

This permit is NOT assignable or transferrable

JAMES F. MEEHAN, Commissioner of Revenue Services

-251 (Rev. 2/90)

Exhibit 6

000177 NOV 1 10

STATE OF CONNECTICUT

Department of Public Health

LICENSE

License No. 0045

General Hospital

In accordance with the provisions of the General Statutes of Connecticut Section 19a-493:

Greenwich Hospital of Greenwich, CT, d/b/a Greenwich Hospital is hereby licensed to maintain and operate a General Hospital.

Greenwich Hospital is located at 5 Perryridge Road, Greenwich, CT 06830

The maximum number of beds shall not exceed at any time:
32 Bassinets
174 General Hospital beds

This license expires **September 30, 2011** and may be revoked for cause at any time.

Dated at Hartford, Connecticut, October 1, 2009. RENEWAL.

Satellites
The Endoscopy Center of Greenwich Hospital, 500 West Putnam Avenue, Greenwich, CT

J. Robert Galvin, MD, MPH, MBA,
Commissioner

Exhibit 7

000179 NOV 1 10

PHILIPS MEDICAL SYSTEMS N.A.
22100 Bothell Everett Highway
P.O. Box 3003
Bothell, Washington 98041-3003
Tel: (800) 722-7900

PHILIPS

Quotation #: 1-QXK0JF	**Rev:** 6	**Effective From:** 05-Oct-10	**To:** 19-Nov-10

Presented To:

GREENWICH HOSPITAL
5 PERRYRIDGE RD
GREENWICH, CT 06830

Tel:

Alternate Address:

Presented By:

Eugene Prendergast
Account Manager
Tel: (914) 806-2268
Fax: (425) 458-0390

Terry Calvin
Regional Manager
Tel: (414) 418-8551
Fax:

Date Printed: 05-Oct-10

Submit Orders To:
22100 BOTHELL EVERETT HWY
BOTHELL WA 98021
Tel:
Fax:(425) 458-0390

IMPORTANT NOTICE: Health care providers are reminded that if the transactions herein include or involve a loan or discount (including a rebate or other price reduction), they must fully and accurately report such loan or discount on cost reports or other applicable reports or claims for payment submitted under any federal or state health care program, including but not limited to Medicare and Medicaid, such as may be required by state or federal law, including but not limited to 42 CFR 1001.952(h).

Quote Solution Summary

Line #	Product	Qty	Price
	100026 Brilliance CT Big Bore	1	$1,248,301.00
		Equipment Total:	$1,248,301.00

Solution Summary Detail

Product	Qty	Each	Monthly	Price
100026 Brilliance CT Big Bore	1	$1,248,301.00		$1,248,301.00

Buying Group: **NO CONTRACT** **Contract #:** **NONE**

Addt'l Terms:

Each Quotation solution will reference a specific Buying Group/Contract Number representing an agreement containing discounts, fees and any specific terms and conditions which will apply to that single quoted solution. If no Buying Group/Contract Number is shown, Philips' Terms and Conditions of Sale will apply to the quoted solution.

Each equipment system listed on purchase order/orders represents a separate and distinct financial transaction. We understand and agree that each transaction is to be individually billed and paid.

Payment Terms: 10% With Signed Acceptance of the Quotation, 70% Upon Delivery of Major Components, 20% Due When the Product is Available for First Patient Use, Net due 10 days from receipt of invoice

System Type: New
Freight Terms: FOB Destination
Warranty Terms: Part numbers beginning with two (2) asterisks (**) are covered by a System 12 Months Warranty. All other part numbers are third (3rd) party items.
Special Notations: Contingencies must be removed 120 days before scheduled shipment to assure delivery on specified date. Any rigging costs are the responsibility of the Purchaser.
Additional Terms:

Line #	Part #	Description	Qty
1	**NNAC196	**Brilliance CT, Big Bore Scanner with Oncology Ent**	1

Brilliance CT systems are powered not only by intelligent technologies inside, but also by stunning advances in how people can interact with the systems from the outside. Both are critical in handling the large amounts of data provided by multi-slice imaging - and in helping achieve a sustainable competitive advantage.

The Brilliance CT Big Bore configuration incorporates the 85 cm large bore and 60 cm true scan field of view as well as the heavy-duty technologies throughout, making this configuration ideal for dual use environments, like oncology where patient positioning and accuracy are especially critical, interventional, emergency department, bariatric and general radiology studies where access, speed, and throughput are especially critical. This system is capable of performing any exam at any time and over time.

Highlights

- 85 cm bore size and 60 cm scan field of view
- 16-slices per revolution for large volumes and thin slices -- exam, after exam.
- Philips MRC X-ray tube with legendary reliability and nearly instantaneous cooling.
- RapidView - The fast reconstruction system keeps pace with acquisition for true real-time imaging.
- DoseWise design delivers optimal dose efficiency, without compromising image quality.
- Brilliance Workspace user environment improves productivity by working the way the user does.
- Logical Guided Flow prompts the user through the scanning and visualization processes.
- ScanTools and ScanTools Pro to optimize productivity, workflow, and diagnostic confidence.

The flexibility of this high performance scanner includes features designed to automate clinical exams, ease through reconstruction and post-processing, and aid in accuracy of diagnoses. Above all, the speed and usability of the Brilliance CT Big Bore configuration positively impacts everyday workflow and increases patient throughput throughout the entire workflow process:

- Patient handling and setup
- Scan and image acquisition
- Dose management
- Reconstruction and display
- Post-processing and communication

Philips has created a comprehensive package of Brilliance CT ScanTools containing advanced components and productivity features that make workflow smooth and easy. From start to finish, they provide everything necessary to streamline routine imaging studies.

Scan Tools Pro is a supplemental set of tools that improve productivity, workflow, and diagnostic confidence even further. Scan Tools Pro includes features like DICOM Modality Worklist, Split

Line #	Part #	Description	Qty

Study, Prefetch Study, Automatic Procedure Selection, Bolus Tracking, Spiral Auto Start, Organ ID, CD Writer, and Dual Monitor Configurations.

CT User Environment

Brilliance Workspace

The Brilliance Workspace user environment is flexible and available wherever it is needed. Designed in collaboration between Philips and its customers, it is a powerful set of CT applications that improves productivity by working the way a user does. Users can do all of their planning, scanning, visualization and archiving in a simple, easy-to-use graphical user interface (GUI) that is harmonized across Philips Healthcare.

Guided Flow

Logical Guided Flow graphical user interface increases productivity through ease-of-use features:

- Features and functions are visible, not hidden.
- Most common operations are shown most prominently.

A top-level workflow bar directs the user along important tasks and provides non-linear movement between functions without losing any current work. This provides the user with maximum flexibility for viewing, performing applications, filming or reporting.

Patient handling and setup

Philips' "Design for Life" approach provides high levels of flexibility for users and comfort for patients. Philips helps improve productivity during patient handling and setup through a variety of features, making patients more comfortable and making technologists' jobs easier.

Gantry

Scan Control Panel

Controls and displays for gantry tilt, patient couch elevation and stroke are located on both sides of the gantry.

Scan Control Box (ScanTools)

Gantry and patient couch controls and displays are located conveniently at the operator's console. Additional functions include emergency stop, intercom, and scan enable/pause buttons.

Gantry Aperture: 850 mm diameter
Gantry Tilt: -30° to +30°; 0.5° increments.

AutoVoice (ScanTools)

A standard set of commands for patient communication: before, during and after scanning.

Multi-lingual AutoVoice (ScanTools)

Commands for patient communication in multiple languages including: English, French, Spanish, Italian, Japanese, Hebrew, Arabic, Russian and Georgian. Also provides the ability to record customized messages - up to 25 seconds per message.

Intercom System: Two-way intercom allows patient monitoring and communication.

Table (Bariatric Patient Support)

The Brilliance Bariatric Patient Support is designed to meet the CT imaging needs of the growing bariatric (morbidly obese) population. Allowing for patient loads of up to 295kg (650 lbs.), the

Line #	Part #	Description	Qty
		100626 Brilliance CT Big Bore	

Bariatric Patient Support provides CT imaging access to a larger patient population than current offerings.

Patient Support Specifications:

Longitudinal motion:

Manual Stroke:	1890 mm
Scannable range:	1750 mm
Speed:	0.5 to 100 mm/sec
Position accuracy:	±0.25 mm

Vertical motion:

Range:	578 to 1028 mm; 1.0 mm inc.

Table load capacity: 295 kg (650 lbs)

Floating tabletop: Carbon-fiber table top with foot pedal and handrail control for easy positioning and quick release.

Table Accessories

From extra padding to optimal support, these table accessories prevent fatigue and discomfort and give both patients and technologists a sense of security: patient restraint kit, table extension, standard head holder, table pad, IV Pole, arm rests, cushions, and pads.

Radiology Flat Top Kit

This kit, comprised of a wide accessory flat top, wide mattress pad and extra long patient restraint straps, provides additional comfort and security for patients. A quality assurance phantom holder fitted for the flat top is also included. Note: This flat top is not qualified for oncology radiation therapy usage.

Scan Planning

The Brilliance Workspace provides intuitive registration and easy entry of patient information and clinical procedure selection, using anatomic graphical display and sample images.

Expert Protocol Planning (ScanTools)

Tailor protocols to meet specific needs via a selection of parameters optimized for certain studies.

Preset Post-processing (ScanTools)

User-defined presets improve workflow, by automatically opening the relevant post-processing applications for a specific type of exam. For example, automatically launching CTA studies in MIP or spine studies in MPR.

Surview Plan

Planning via interactive mouse control of multiple, independent acquisition series of any type on Surview image

Scan length:	up to 1500 mm
Scan width:	600 mm

Dual Surview Planning (ScanTools)

Planning patient scans with two surviews provides flexibility in exam planning and execution, and also avoids repeat scans.

Multi Surview Planning (ScanTools)

Requested by radiation oncology users where patient positioning and alignment is critical, Multi Surview allows user to repeat the AP and LAT surviews until satisfied that their patient is properly aligned on the table top.

Manual Scan

Places slice-by-slice scans under operator control with on-line or off-line reconstruction,

background image archiving to local or remote storage devices. At any time, the operator is able to switch from automatic to manual scan and back.

Automatic Scan
Enables automatic execution of pre-planned studies, with concurrent, on-line or off-line reconstruction, background image archiving to local or remote storage devices, without operator intervention.

Productivity Tools
QuickStart (ScanTools)
Brilliance CT scanners have an efficient start-up sequence that allows scanning to begin within five minutes after turning the system on.

QuickSetup (ScanTools)
System utilities such as quality assurance tools and service functions are readily available with a single mouse click.
DICOM® Modality Worklist (ScanTools Pro)
Provides HIS/RIS interface through DICOM Modality Worklist service class; enhances clinical workflow by importing patient demographics and study information from an information management system.

Split Study (ScanTools Pro)
Many times multiple orders or accession numbers are generated for a patient's CT scan that require only a single scan acquisition. In these instances Philips' Split Study feature allows the user to virtually split the acquisition so that proper accession numbers are assigned to specific areas of the scan acquisition (i.e. chest slices to the chest accession number, etc.) and billing and tracking is completed accurately and appropriately. By assigning the accession numbers quickly and easily during scan setup, scan information is matched accurately in all subsequent steps (matching, reporting, archiving, billing, etc.). Philips' Split Study reduces error and improves workflow efficiency.

Prefetch Study (ScanTools Pro)
This feature searches the database (PACS) for previous patient studies (CT, MR, CR, RF). After location and selection, these studies are then sent to the background of the configurable destination (e.g., Extended Brilliance Workspace).

Automatic Procedure Selection (ScanTools Pro)
Maps the procedure selection from the HIS-RIS with individual scan protocol(s) from the Brilliance CT scanners, simplifying the scanning process. Only the most relevant scan protocol(s) for any requested procedure are shown to the user, ensuring that only the desired scanning procedures are performed. This is especially useful for infrequent users of the CT scanner.

Scan and image acquisition
Reliable, maximized system performance allows clinicians to remain focused on patient care. Brilliance CT is perfectly balanced, combining power and flexibility that maximizes image quality, speed and throughput while lowering patient dose.
System: Rotate-rotate architecture with optimized geometry for low dose imaging.

Generator
The Brilliance generator uses modern, low-voltage slip ring technology to provide a constant high voltage to the CT x-ray tube assembly.
Output capacity: 60 kW

Line #	Part #	Description	Qty

kV selections: 90, 120, 140 kVp
mA selections: 20 to 500 mA

MRC X-ray Tube
The exceptional heat management demands of multislice imaging calls for an exceptional tube. With its patented spiral groove bearing design, Philips' MRC tube dissipates heat as rapidly as it is collected, with an effective heat storage capacity far superior to a conventional ball bearing design.

- Motion-free focal spot guarantees optimized image quality.
- Absolute noiseless design calms patients.
- 2nd generation of MRC tube technology built on proven record of performance and reliability

Equivalent Heat Storage Capacity: 26 MHU
Anode storage capacity: 8.0 MHU
Maximum cooling rate: 1608 kHU/min
Focal spot (IEC): 0.5 mm x 1.0 mm (small)
1.0 mm x 1.0 mm (large)

Dynamic Focal Spot (ScanTools)
Dynamic Focal Spot (DFS) doubles the data sampling density from the detectors in axial and spiral scanning.

Detector
Detector design is fundamental to the objective of acquiring high quality images while minimizing patient dose. Unlike single matrix detectors that simply sum elements, Philips designs configuration-specific detectors that minimize the separation between elements to always provide the highest geometric detector efficiency. Direct-to-digital signal conversion with TACH technology reduces dose and improves image quality.
Material: Solid State - GOS
Slip Ring: Optical - 2.5Gbps transfer rate
Slice Collimation: 16 x 0.75mm, 16 x 1.5mm, 8 x 3.0mm, 4 x 4.5mm, 2 x 0.6mm

Image Quality
Spatial Resolution
High mode: 15 lp/cm @ cut-off
Standard mode: 12 lp/cm @ cut-off
Noise: 0.27% measured on Philips system phantom (21.6 cm water equivalent)
Low Contrast Resolution: 4.0 mm @ 0.3% as measured on the 20 cm CATPHAN phantom
Absorption Range: -1024 to +3072 Hounsfield units

Scanning Modes
Spiral Scanning

- Multiple contiguous slices acquired simultaneously with continuous table movement during scans.
- Multiple, bi-directional acquisitions

Spiral exposure: Up to120 sec. of uninterrupted spiral scanning
Spiral pitch: 0.04 to 1.7 (user selectable)

Axial Scanning

- Multiple-slice scan with up to 16 contiguous slices acquired simultaneously with incremental table movement between scans

Line #	Part #	Description	Qty

- Fused modes for reconstructing partial volume artifacts free thick slices from thin slice acquisition

Scan Times
0.44, 0.5, 0.75, 1, 1.5, 2 seconds for full 360° scans

Test Injection Bolus Timing (ScanTools)
This feature establishes the optimum delay time for contrast injection. By using a test injection, a real-time graph of the enhancement in the selected region of interest is displayed. The delay time is then selected to provide optimal peak contrast enhancement and reduced contrast usage - ideal for CTA.

Bolus Tracking (ScanTools Pro)
This automated injection planning technique permits the user to monitor actual contrast enhancement and initiate scanning at a pre-determined enhancement level. Combine with SAS for full automation and efficacy.

Spiral Auto Start (ScanTools Pro)
Spiral Auto Start integrates the injector with the scanner, allowing the technologist to monitor the contrast injection to check for extravasation, and to initiate and stop the scan (with the pre-determined delay) while in the scan room.
NOTE:
- Costs to upgrade an approved injector and any cabling is the responsibility of the user.
- Compatible with following Injectors: Medrad Envision/Stellant, Medrad Vistron, Liebel-Flarsheim, Tyco CT 9000, Medtron CT 2, Nemoto Dual Shot, Tyco OptiVantage DH, E-Z-EM Empower, Swiss Medicare, Ulrich Injectors

Dose Management
Philips' DoseWise philosophy is a set of principles and practices that ensures the best possible outcomes with minimal risk to patients and staff. Brilliance CT systems employ a number of features that help provide extremely high dose efficiency.

DoseRight ACS (Automatic Current Selection) (ScanTools)- Optimizes the dose for each patient based on the planned scan by suggesting the lowest possible mAs settings to maintain constant image quality at low dose throughout the exam.

DoseRight D-DOM (Dynamic Dose Modulation) (ScanTools)- Automatically controls the tube current rotationally, increasing the signal over areas of higher attenuation (lateral) and decreasing signal over area of less attenuation (AP).

DoseRight Z-DOM (Longitudinal Dose Modulation) (ScanTools)- Automatically controls the tube current, adjusting the signal along the length of the scan, increasing the signal over regions of higher attenuation (shoulders, pelvis) and decreasing the signal over regions of less attenuation (neck, legs).

Dose Displays

- Volume CTDI (CTDIvol) (ScanTools)
- Dose Length Product (DLP) (ScanTools)
- Dose Efficiency (ScanTools)

Dedicated Pediatric Protocols (ScanTools)
Developed in collaboration with top children's hospitals, Brilliance age and weight-based infant and pediatric protocols ensure the best clinical results with minimal dose.

Reconstruction and Display
RapidView 4D Reconstruction
RapidView 4D reconstruction is the result of years of advanced research, and was designed to forever remove the bottleneck between CT scan acquisition and image visualization. RapidView 4D provides dramatic improvements in Pulmonary Retrospective 4D imaging workflow by displaying images at breakthrough rates, regardless of acquisition speed or reconstruction parameter. The RapidView 4D system employs true cone beam reconstruction algorithms and Philips-patented back projection hardware to provide the user with the images they desire, along with best-in-class reconstruction speeds, without compromise in image quality.
Reconstruction Rate: *Up to 20 images per second*

Cone Beam Reconstruction Algorithm- COBRA (ScanTools)
Philips patented Cone Beam Reconstruction Algorithm (COBRA) enables true three-dimensional data acquisition and reconstruction in spiral scanning. This avoids and/or corrects artifacts present in reconstruction by reducing pixel to noise ratio, resulting in superior multislice image quality.

Reconstruction Modes
Concurrent: Axial and spiral modes - image reconstruction concurrent with acquisition
Off-Line (batch): Background image reconstruction of user-defined groups of raw data files with automatic image storage.

Evolving Reconstruction (ScanTools)
Provides real-time 256 x 256 matrix image reconstruction and display in step with spiral acquisition. Images can be modified for window width and level, zoom and pan prior to reconstruction. At the end of the acquisition, all images are updated with the desired viewing settings.

Add Reconstruction (ScanTools)
Enables quick and easy unplanned or modified reconstructions of part or all of the images prospectively or retrospectively planned.
Extended Display Field of View
Enables extrapolated reconstruction for visualization of anatomy out to 70cm. Useful in radiation oncology for avoidance in treatment planning. Also may be useful for evaluating out of field artifacts, contouring skin, and bariatric or off-center scanning. Data outside of 60cm shall not be considered to be of diagnostic quality; CT numbers may not be accurate and image quality may be degraded in this region.

Reconstruction parameters
Any study can be set up to automatically reconstruct using various reconstruction parameters. Exams can be tailored online while planning the scan, or during off-line recon. Up to six different reconstruction assignments are possible for each study. Image reconstruction parameters include image matrix, filters, enhancements, zoom and pan, and archive.

UltraImage (ScanTools)
UltraImage includes proprietary pre- and post-processing hardware and software for enhanced visualization of soft tissue structures. UltraImage significantly improves image quality for the most accurate representation of even the most difficult to image anatomic areas, such as the bone-brain-air interface in neurological exams. The full clinical impact of UltraImage is best appreciated

Line #	Part #	Description	Qty

in the brain, long bones, spine, pelvis or shoulder, where subtle, soft tissue structures can be obscured by adjacent high contrast bone.

Adaptive Filtering
Adaptive filters reduce pattern noise (streaks) in non-homogenous bodies, improving overall image quality.

Post-processing and communication
Image Processing *(ScanTools)*
The interactive image viewer is designed for fast, efficient and simple image review and filming purposes. Images can be handled individually or in user-selected groups.

- Image viewer window: Displays a single image or a selection of images.
- Zoom & Pan: Magnification from 0.8 to 10 times
- Scroll Bar, Leaf and Cine, Invert Image, Image Parameters Display

Organ ID (ScanTools Pro)
Automatically isolates lung images for better viewing, including lung limit detection, zoom and pan setting, lung windowing, image enhancement, and image filming.

Image Graphics (ScanTools)
To help interpret clinical images, a variety of text and graphic aids can be individually positioned and manipulated with the mouse:

- Text annotation
- Cursors for pixel value measurements.
- Regions of Interest (ROI) - elliptical, rectangular, curved or freehand, with instantaneous calculation and display of area, average pixel value and standard deviation. Values of several ROIs may be added or subtracted.
- Lines, grid and scales for distance measurements, curved and freehand lines for measuring any shape.
- Arrows for pointing to features.
- Angle measurements.
- Histogram of pixel values in a user-defined region of interest.
- Profile of the pixel values along any line.
- Grid with adjustable spacing for distance assessment

Window Control *(ScanTools)*

- Eight user-defined preset windows provide fast and convenient window setting. Mouse-driven fine adjustments of the window center and width enable optimal image viewing
- Highlight Window: paints user-defined range of CT densities in color.
- Double Window: Simultaneous displays two independent CT density ranges on the same image, i.e. thorax slice with lung and mediastinum windows
- Invert Window: Ability to toggle between negative and positive image.

Host Computer
Computer Architecture: Windows XP Dell Precision host
Main Memory: 4.0 GB RAM.
Display Monitor
Dual Monitor Configuration (ScanTools Pro)
Expands the Brilliance workspace by utilizing two flat panel monitors side-by-side. The left monitor is utilized for scanning operations while the right is used for post-processing activities. These

Line #	Part #	Description	Qty

high-resolution, flat panel LCD, color monitors save space and weight when compared to conventional CRT-based monitors.

Post-Processing Analysis Tools
SlabViewer (ScanTools)
MPR- Multiplanar Reformation (ScanTools)
Maximum or Minimum Intensity Projection (MIP) (ScanTools)
3-D SSD Reconstruction (ScanTools)

MasterCut (ScanTools)
With the MasterCut feature, MPR (Multiplanar Reformatting) curved cuts along vascular structures can be defined on Maximum Intensity Projection (MIP) or volume rendered images to display panoramic and cross-sectional views that accurately visualize the vasculature.

RelateSlice (ScanTools)
RelateSlice is a Philips-exclusive tool provided in Volume Rendering, 3-D SSD, MIP, and MPR, that correlates the axial image to a user-selected location on multiplanar views and renderings. RelateSlice makes it easy for a user to compare the axial image to its post-processed presentation, improving the user's productivity and diagnostic confidence.

Masterlook (ScanTools)
An automated real-time image enhancement, or smoothing, that can be defined for up to three independent density ranges, such as lung, soft tissue and bone.

3-D Small Volume Analysis (ScanTools)
3-D Small Volume Analysis permits tumor or nodule characterization with respect to growth rates within the 3-D application. This tool uses automatic segmentation for help in identifying a solitary nodule or tumor (early staging of lung cancer), and measures volumetric parameters such as nodule volume, long axis, and short axis for follow-up purposes.

Q-CTA - Quantitative CT Measurement Tool Package (ScanTools)
Q-CTA is a tool kit for quantitative measurements of anatomic structures, such as vasculature pathology from 2-D, 3-D or volume-rendered images.
Volume Rendering (ScanTools)
Philips advanced volume rendering 3-D visualization software provides unique simultaneous visualization of vasculature, soft tissue and bone. Unlike conventional 3-D or MIP, volume-rendering visualization offers real time interactive control over opacity and transparency values. This permits viewing through and beyond surrounding structures, such as metallic stents and arterial calcifications, and virtually eliminates the need for organ segmentation.

Image Management and Archiving
Image archiving is organized according to the DICOM 3.0 hierarchical model, in a DICOM 3.0 compliant image format. Loss less image compression/decompression algorithm is used during image storage/retrieval to/from all local archives. Images can be auto-archived to selected archive media.

292 GB Hard Disk:
Image Storage Capacity: 512 X 512 Image Matrix = 500,000 typical number of uncompressed images

DVD-RAM
DVD-RAM is an archive solution for storing CT and other modality datasets. It provides an inexpensive, reliable method for high-speed random access recording. DVD-RAM is intended as

Line #	Part #	Description	Qty

a storage replacement to the EOD and supports multi-session writing in order to store multiple patients added to the disk at different times. DVD-RAM disks are written with proprietary Philips format and are only readable on Philips EBW (v3.0.1 or higher) and CT scanner units (v2.3 or higher) with DVD-RAM.

4.7 GB DVD:
Image Storage Capacity: 512 X 512 Image Matrix = 15,000 typical number of uncompressed images.

CD Writer (ScanTools Pro)
A Compact Disk (CD) drive stores DICOM images plus DICOM image viewing software, on very low cost CD media. The CD Writer permits a standard PC with a built-in CD drive to view and perform basic manipulations (zoom, pan, and window level) on the DICOM images stored on the CD. This Brilliance enhancement provides a low cost and flexible alternative for archiving and retrieving images, copies for referring physicians, and to use in presentations and teaching.

- Minimum PC hardware Requirements are a Pentium III 450 MHz with 128 MB RAM main memory and a 20 GB Hard Drive running Microsoft Windows operating systems
- Supported Web Browsers which must be installed in Compact or Full mode include Microsoft Internet Explorer or Netscape installed with ActiveX Plug-in. Macintosh viewing support via the "Virtual PC" application. ;

CD:
Image Storage Capacity: 512 X 512 Image Matrix = 1,200 typical number of uncompressed images

Filming
The Brilliance filming function allows the user to set up and store desired filming parameters. Pre-stored protocols can also include auto-filming. The operator can film immediately after each image, at the end of a series, or film after the end of a study and review images prior to print. The operator can also automatically film the study at three different windows and incorporate Combine Images functionality to manage large datasets. Basic monochrome and color DICOM Print capability are supported.

Networking/Connectivity
Network Requirements
Network connections should be located within 10 feet of the console. The Brilliance CT supports 10/100/1000Mbps (10/100/1000BaseT) network speeds. For optimal performance, Philips recommends a minimum of 100Mbps network speed (1Gbps preferred) and for the CT network to be segmented from the rest of the hospital network.
DICOM Connectivity
Brilliance Workspace's full implementation of the DICOM 3.0 communications protocol allows connectivity to DICOM 3.0 compliant scanners, workstations, and printers; supports IHE requirements for DICOM Connectivity.

Remark: Customers using the old SPARC II platform of the AcQSim Voxel Q need to consider that Brilliance 2.0 will not be compatible. For customers with the UltraSparc platform of the AcQSim Voxel Q, version 5.0.2 or above is needed to maintain connectivity with Brilliance 2.0.

Siting information
Power Requirements

Line #	Part #	Description	Qty

- 200/208/240/380/400/416/480/500 VAC at 100 kVA and 50/60Hz
- Three-phase distribution source

Computer cabinet is included. Computer table and operator's chair are optional.

Clinical Education Program for Brilliance CT Big Bore Oncology Systems:

All Clinical Education Training courses listed below are entitlements for this Brilliance CT System. No substitutions are allowed. All training courses will expire one year after the system delivery.

989801292234: Essentials Off-Site Education: Philips will provide up to two (2) lead simulation therapists, as selected by customer, with in-depth lectures covering basic clinical applications, Philips-specific imaging techniques, protocol optimization and scan parameters. A Brilliance CT "system emulator" is used during the lab sessions to simulate all basic scanning operations without x-ray exposure. Students will graduate from this class with an 80% understanding of the base system functionality. The remaining 20% is covered during the Handover On-Site experience. This twenty-eight (28) hour class is located in Cleveland, Ohio, and is scheduled based on your equipment configuration, geography, and availability. Due to program updates, the number of class hours is subject to change without notice. Customer will be notified of current, total class hours at the time of registration. This class is a prerequisite to your equipment handover On-Site Education, and should be attended no earlier than two weeks prior to system installation. ASRT CEU credits may be available for each participant that meets the Guidelines provided by Philips during the scheduling process. **Travel and lodging are not included, but may be purchased through Philips. It is highly recommended that 989801292078 (CT Full Travel Pkg. Off-Site) is purchased with all Off-Site courses.**

989801292194: Handover On-Site Education: Clinical Education Specialists will provide twenty-four (24) hours of education for up to three (3) dedicated Therapy staff members. This training will encompass all aspects of data acquisition for CT Simulation. Day 1 is reserved for acceptance testing and commissioning if required. ASRT CEU credits may be available if the participant meets the Philips Guidelines. Note: Site must be patient-ready. Philips personnel are not responsible for actual patient contact or operation of equipment during education sessions except to demonstrate proper equipment operation.

989801292080: Follow-Up On-Site Education: Clinical Education Specialists will provide twenty-four (24) hours of education for up to three (3) dedicated Therapy staff members, selected by customer. This course covers Tumor LOC and Respiratory Correlated Imaging. Schedule patients based on Training Guidelines. CEU(s) are not available at this time. Note: Philips personnel are not responsible for actual patient contact or operation of equipment during education sessions except to demonstrate proper equipment operation.

It is highly recommended that 989801292077 (CT Cross Trainer) is purchased.

The above education entitlements expire one (1) year from System installation date (or purchase date if sold separately). Ref#: 234194080-100614

2	**NCTA485	**Keyboard Language - English**	1
3	**NCTA131	**Computer Table**	1

Computer table for the Extended Brilliance Workspace

Provides a large enough working space (120cm) to accommodate dual monitors and other peripheral devices (barcode phone log books etc.) and matches the Brilliance CT Scanner design.

Line #	Part #	Description	Qty
4	**NCTA531	**Pulmonary Toolkit for Oncology**	1

Philips' Pulmonary Toolkit for Oncology includes three different modes of operation and supports two respiratory sensor devices. Pulmonary Viewer and 0.4 second rotation speed are also included.

Prospective Axial enables the user to trigger an axial scan at a particular breath level (threshold). The clinical usefulness in diagnostic radiology is that it minimizes artifacts due to respiratory motion for those patients who are not able to hold their breath during the scan. In radiation oncology, the prospective axial dataset may be used for planning gated treatments. By matching the scan phase with the treatment phase the clinician can be assured of providing the CT simulation plan that delivered the highest tumorcidal dose while maximizing the amount of healthy tissue that is spared.

Prospective Spiral enables the user to visualize the breathing waveform and begin a spiral scan at a desired breath level. This mode is used in conjunction with breath-hold imaging (typically followed by breath-hold gated treatments).

Retrospective Spiral (4D CT) results in the ability to generate multiple phases allowing for visualization of motion during the respiratory cycle. This mode entails acquiring an over-sampled ultra low pitch spiral scan of the thorax or desired area, and correlating it in reconstruction with the patient's breathing. The resulting images can be used to assess motion of the tumor and critical organs, to make decisions about gating the radiotherapy delivery, and to delineate a target volume that encompasses the entire range of tumor motion.

The Philips Bellows device is a pneumatic mechanism placed around the patient's chest, dynamically observing changes in pressure caused by motion of the chest with a transducer linked to the Brilliance CT scanner.

Another respiratory sensor supported is the Varian RPMTM, for which an interface cable is provided. The Varian RPMTM device itself is not included. The customer should contact their Varian Medical Systems representative to ensure their RPM configuration is correct for Philips Brilliance CT. RPM 1.6 and 1.7 are compatible.

Pulmonary Viewer is a dedicated software package to aid clinician in making radiation therapy treatment planning decisions. Pulmonary Viewer provides the ability to visualize one or multiple respiratory phases, analyze and determine extent of motion, and review the patient's respiratory waveform. The comprehensive set of user tools includes cine mode with adjustable speed for visualizing motion over time and interactive slab-MIP tools.

Remark: Compatible with RPM version 1.6 and 1.7. For Brilliance 16, 16P, 40, and 64, version 2.2.5 software or higher is a pre-requisite.

5	**NCTB110	**Therapy Table Top Kit**	1

A comprehensive patient positioning system, the Brilliance Therapy Tabletop Kit is designed to enhance treatment effectiveness and ensure maximum clinical efficiency. Featuring Indexed Immobilizationtm (trademark of Varian Medical Systems Inc), patient setup time is reduced and positioning for subsequent scans and treatment is easily duplicated. The Therapy Tabletop supports immobilization accessories that deliver the precision required for conformal and stereotactic procedures. These accessories significantly enhance positioning accuracy and patient comfort. The indexed surface allows the positioning system to be locked into place according to the treatment plan's specifications.

The kit includes the Therapy Tabletop, Phantom Holder, water level phantom, and laser calibration bar. The Phantom Holder fits over the Therapy Tabletop, allowing the user to run calibrations with the QA phantom while the Therapy Tabletop is still attached.

Line #	Part #	Description	Qty

Pre-requisite: Bayonnet style couch is required. The Therapy Tabletop cannot be used to support the iCT calibration phantom.

6 **NCTC910 Tumor Loc 1

This Brilliance CT Tumor Localization package meets the clinical requirements of oncology departments where segmentation and localization can be completed directly on the CT display console. The package provides tools to assist in Isocenter localization and simple CT Simulation. In addition to standard studies, these tools are available for respiratory correlated studies, including all phase information. Visualization capabilities within the Tumor LOC package include the generation of Digitally Reconstructed Radiographs (DRR), Digitally Composited Radiographs (DCR), and Multiplanar reformatted images (MPR). Additionally, the package provides the ability to manage different window/level settings to aid in generating the best images possible. Special visualization tools for respiratory correlated scans are also included.

- Segmentation and localization.
- Efficient advanced contouring of external and critical structures in preparation for the radiotherapy treatment planning process.
- Visualization and analysis tools can be utilized to evaluate the treatment volume(s)
- Tools for visualizing and analyzing respiratory correlated datasets (4D)

This Brilliance CT Tumor Localization Package has been specially configured to:
- Provide additional Brilliance Big Bore Scanner display console functionality that allows for increased productivity and improved workflow by minimizing CT simulation time, and enhancing the patient marking process.

Brilliance CT Tumor LOC Basic Software License:

Features and capabilities provided by the Brilliance CT Tumor LOC software include:

Contour-Based Segmentation Package: Consists of drawing and editing tools for drawing contours and maintaining groups of contours used in hand segmenting image data. Tools also exist for interpolation functions for automatic and semi-automatic segmentation. Automated generation of an external contour can be preselected as a user defined preset.

Virtual Fluoroscopy using orthogonal beam divergent DRR's for isocenter and beam border placement.

Interpolate algorithm provides interactive, shape based interpolation. A Smart algorithm fills in any number of irregularly contoured slices, Interpolated contours may be edited, accepted or rejected.

Isocenter Management:

Isocenter menu to support and manage multiple isocenters. Supports the generation of separate isocenters for multiple target volumes or general regions. Marked and final Isocenters are reported and displayed in the Localization package for easy confirmation of a physical simulation session. A record of the simulation session may be printed on a standard printer. If configured, RT Plan can easily be exported to the laser system for a more streamlined marking procedure. Tumor LOC is

Line #	Part #	Description	Qty

only compatible with LAP CT-4-3 lasers. DicomConnect plugin from LAP is necessary in order for the automatic transfer of isocenter coordinates to work.

Isocenters and structure sets can be transmitted to a compatible RTP System capable of receiving DICOM RT structure set, plan, and RT Image.

2D Image Analysis: Enables viewing of the data exactly as it was acquired, prior to any interpolation and with no preprocessing.
Markers: Permits the display of a fixed marker (cross hairs, axis or grid) on the screen as an aid in isocenter marking, or image positioning.
Screen Annotation: Allows the operator to toggle selected screen annotations on and off.
Archive: Allows the user to archive a patient study from disk onto selected archive media.
Information: Displays the study's original scan information, including the number of slices in the study, slice thickness, etc. Can be displayed at any time during an analysis.
Control of Window/Level: Allows adjustment to achieve optimal viewing parameters.
Measurement Package: Provides the density value (in Hounsfield units if CT) of a particular point on an image. Computes distances along straight lines.
Pan: Permits the repositioning of any image within a viewport.

Tools to allow visualization of organ motion and to assist physician in determining best treatment are the following:
Import of multiple phase datasets as well as a routine CT
Contour on any phase and apply it to a chosen primary phase
Dynamic DRR/DCR
Dynamic MPR & Axial
Maximum, minimum, and average intensity projection dataset generation

Remarks: The Brilliance Tumor LOC will now be available on the Brilliance Big Bore CT Configuration as an option

7	**NCTA082	**30-min Console UPS**	1

Uninterruptible Power Supply (UPS) provides up to 30 minutes of battery backup for computer/reconstruction system.

8	**989605200521	**Teal 100kVA Isotran Plus**	1

Teal 100 kVA isolation voltage adapting transformer:

Input voltage: 200/208/240/380/400/416/480/500, 3-phase, delta plus protective earth. 50/60 Hz
Output voltage: 480 VAC (277 VAC wye).
Includes: Programmable input circuit breaker.
Includes: TVSS (Transient Voltage Surge Suppression), load side filtration for noise attenuation and remote control contactor.
Weight: 598 lbs. (271 kg)
Dimensions: 27.8" (70.7 cm) wide, 20.5" (52.1 cm) deep, 44.0" (111.8 cm) high.

9	**NCTC930	**Oncology Workflow & Image Quality Enhancement Pkg**	1

Line #	Part #	Description	Qty

Includes a comprehensive set of options especially tailored for radiation therapy departments who want to enhance workflow and improve IQ. It's everything you need to improve IQ and CT localization/simulation workflow on the CT console which includes CT Sim on Console, Metal Artifact Reduction and Amplitude Binning for 4D correlated image Studies!

CT Sim on Console
Meets the clinical needs of Radiation Therapy departments where segmentation, localization and fast emergency sim and treats can be completed directly on the CT display console. CT Sim now will provide tools to assist in isocenter localization and fast CT simulation with blocking/MLC capabilities and machine characterizations.
CT Sim on Console:
- Provides Localization of treatment isocenter
- Increases productivity and improves workflow.
- Minimizes simulation time while enhancing the patient marking process.
- Provides Visualization and analysis of treatment beam geometry and beam modifiers
- Provides Efficient, advanced machine characterization preparation for radiotherapy CT Simulation.

Metal Artifact Reduction
Metal Artifact Reduction supports the image quality needs of Radiation Therapy departments by reducing artifacts in image data caused by large high density metal objects such as prosthetic hip replacements.
Metal Artifact Reduction improves:
- Treatment accuracy
- Visualization of critical structures
- Visualization of target volumes

Amplitude Binning
Amplitude Binning for 4D correlated imaging is a "new Philips feature that uses a proprietary algorithm that utilizes the amplitude of the respiratory signal in addition to phase base information when creating 4D-CT volumes. Amplitude Binning a unique binning process that compensates for the patients uneven breathing pattern.
The resulting images may aid the Radiation Oncologist in:
- Assessing motion of the tumor and critical organs.
- Making decisions about gating the radiotherapy delivery.
- Delineating a target volume that encompasses the entire range of tumor motion.

10	**989801292069	**16 Hours of Additional OnSite Clinical Training**	1

Clinical Education Specialist will provide sixteen (16) hours of tailored CT OnSite Education for up to four (4) students, selected by customer, including technologists from night/weekend shifts if necessary. CEUs are not available in all cases. Please read Guidelines for more information, which will be provided to you during the scheduling process. Note: Philips personnel are not responsible for actual patient contact or operation of equipment during education sessions except to demonstrate proper equipment operation. Education expires one (1) year from the earlier of equipment delivery date or purchase date.

11	**989801292078	**Full Travel Package for OffSite Training**	3

Includes one (1) participant's airfare from North American customer location to Cleveland, Ohio, with modest lodging, ground transportation, and meal expenses. Breakfast/dinner provided by the hotel, and lunch/breaks are catered by Philips. All other expenses will be the responsibility of the attendee. Details are provided during the scheduling process.
Note: Cancellation/rescheduling policy strictly enforced.
Expires one (1) year from the earlier of equipment delivery date or purchase date.

Line #	Part #	Description	Qty
12	**989801292279	CT ONC Motion Mgt Rad Therapy	4

This 2-day course is held at Washington University School of Medicine, St Louis MO, and is intended for radiation oncologists, medical physicists, dosimetrists, therapists, and others who want to gain exposure to Respiratory Correlated Imaging and understand the benefits of how it can be implemented in their clinical environment to improve patient care. The course is taught by physicians, medical physicists, and other professionals from an institution leading the way in this area. The course consists of lectures, discussions, and hands-on learning lab exercises. Topics include clinical indications, scanning process, review and analysis of 4D CT studies, treatment planning, commissioning and QA, and treatment delivery. The goal is to facilitate easier implementation of respiration motion management using Philips equipment in the attendee's clinic.

Accreditation will be offered for CAMPEP, ASRT and MDCB. Philips Oncology Schedule Coordinators manage course dates and scheduling. Program updates, course dates/times, and topics are subject to change without notice. Attendees receive updated information regarding schedule changes. This quote covers tuition costs for one (1) person. Travel, lodging and transportation are the responsibility of the attendee.

Cancellation Policy For MMRT Course:

Cancellations made in writing 60 days prior to the first day of the course will be refunded less a $300 administrative fee. Cancellations made in writing between 30 and 60 days prior to the first day of the course will be subject to a 50% cancellation fee. No refunds will be given less than 30 days prior to the first day of the course. No telephone cancellations will be accepted. In the unlikely event that the course is cancelled by the training site, Washington University will refund the registration fee, but is not responsible for any travel costs. Attendee is responsible for any cancellation fee incurred.

13	**989801292428	CT ONC Brill Ess Add OffSite 28h	1

Philips will provide one (1) lead simulation therapist, as selected by customer, with in-depth lectures covering basic clinical applications, Philips-specific imaging techniques, protocol optimization and scan parameters. A Brilliance CT "system emulator" is used during the lab sessions to simulate all basic scanning operations without x-ray exposure. Students will graduate from this class with an 80% understanding of the base system functionality. The remaining 20% is covered during the Handover OnSite experience. This twenty-eight (28) hour class is located in Cleveland, Ohio, and is scheduled based on your equipment configuration, geography, and availability. Due to program updates, the number of class hours is subject to change without notice. Customer will be notified of current, total class hours at the time of registration. This class is a prerequisite to your equipment handover OnSite Education, and should be attended no earlier than two weeks prior to system installation. ASRT CEU credits may be available for each participant that meets the Guidelines provided by Philips during the scheduling process. Travel and lodging are not included, but may be purchased through Philips. It is highly recommended that 989801292078 (CT Full Travel Pkg OffSite) is purchased with all OffSite courses.

14	SP007	Rigging Charges	1

Saturday Rigging of CT Scanner to Second Floor with Crane

15	SP111	Ambient Design	1

Room Design Placeholder

Line #	Part #	Description	Qty
16	Third Party Item	**LAP Green DORADOnova with DicomConnect v2.0** LAP Green DORADOnova with DicomConnect v2.0	1
17	Third Party Item	**Image Grid PACS** Candelis Image Grid	1

NET PRICE $1,248,301.00

Buying Group: NO CONTRACT Contract #: NONE

Addt'l Terms:

Each Quotation solution will reference a specific Buying Group/Contract Number representing an agreement containing discounts, fees and any specific terms and conditions which will apply to that single quoted solution. If no Buying Group/Contract Number is shown, Philips' Terms and Conditions of Sale will apply to the quoted solution.

Each equipment system listed on purchase order/orders represents a separate and distinct financial transaction. We understand and agree that each transaction is to be individually billed and paid.

Price above does not include any applicable sales taxes.

The preliminary delivery request date for this equipment is:_____.

If you do not issue formal purchase orders indicate by initialing here_____.

Tax Status:

Taxable_____ Tax Exempt_____

If Exempt, please indicate the Exemption Certification Number:_____, and attach a copy of the certificate.

Delivery/Installation Address:

_____

_____

_____

Invoice Address:

_____

_____

_____

Contact Phone #:

_____

Contact Phone #:

_____

Purchaser approval as quoted:

_____

Date:

_____

Title:

_____

This quotation is signed and accepted by an authorized representative in acknowledgement of the system configuration, terms and conditions stated herein.

Philips Standard Terms and Conditions of Sale

The products and services listed in the quotation are offered by Philips Medical Systems North America Company ("Philips") only under the terms and conditions described below.

1. Price; Taxes. The purchase price stated in the quotation does not include applicable sales, excise, use, or other taxes in effect or later levied. Unless Customer provides Philips with an appropriate exemption certificate reasonably in advance of the date the product is available for delivery, Philips shall invoice Customer for those taxes, and Customer shall pay those taxes in accordance with the terms of the invoice.

2. Cancellation. Philips' cancellation policies are set forth in the applicable schedule attached to these Terms and Conditions of Sale.

3. Payment Terms.

- 3.1 Unless otherwise specified in the quotation, Philips will invoice Customer, and Customer will immediately pay such invoice on receipt for each product in accordance with the payment terms set forth in the applicable schedule attached to these Terms and Conditions of Sale:
- 3.2 Orders are subject to Philips' on-going credit review and approval.
- 3.3 Customer shall pay interest on any amount not paid when due at the maximum rate permitted by applicable law. If Customer fails to pay any amount when due, in addition to any other rights or remedies available to Philips at law or in equity, Philips may discontinue the performance of services, discontinue the delivery of the product, or deduct the unpaid amount from any amounts otherwise owed to Customer by Philips under any agreement with Customer. In any action initiated to enforce the terms of the quotation following a Customer default or product cancellation under an order arising from the quotation, Philips shall be entitled to recover as part of its damages all costs and expenses, including reasonable attorneys' fees, in connection with such action.

4. Trade - In. If Customer will be trading-in any equipment (a "Trade-In"), then
(i) Customer represents and warrants that Customer has, and shall have when title passes, good and marketable title to such Trade-In;
(ii) Title to such Trade-In shall pass from Customer to Philips upon Philips making the new equipment available for first patient use. Removal of the Trade-In from Customer's site shall occur no later than the date Philips makes the new product available for first patient use, unless otherwise agreed between Philips and the Customer ; and,
(iii) Notwithstanding anything to the contrary in any Business Associate Addendum, Customer represents and warrants that Customer has removed or de-identified all Protected Health Information from the Trade-In equipment as of the date the equipment is removed.
(iv) If the condition of the Trade-In is not substantially the same when Philips removes the Trade-In (ordinary wear and tear excepted) as it was when Philips quoted the Trade-In value, then Philips may reduce the price quoted for such Trade-In and
(v) If Customer delays the removal of the Trade-In, then Philips may reduce the price quoted for such Trade-In.

5. Leases. In the event Customer desires to convert the purchase of any product to a lease, Customer will arrange for the lease agreement and all other related documentation to be reviewed and approved by Philips not later than ninety days prior to the date of the availability for delivery of major components of the product. The Customer is responsible for converting the transaction to a lease, and is required to secure the leasing company's approval of all of these Terms and Conditions of Sale. No product will be delivered to the Customer until Philips has received copies of the fully executed lease documents and has approved the same.

6. Security Interest. Customer hereby grants to Philips a purchase money security interest in the products until all payments have been made. Customer shall sign any financing statements or other documents necessary to perfect Philips' security interests in the products. Where permitted by applicable law, Customer's signature on the quotation or on a purchase order issued as a result of the quotation gives Philips the right to sign on Customer's behalf and file any financing statement or other documents to perfect Philips' security interest in the product.

7. Shipment and Risk of Loss.

- 7.1 The applicable schedule attached to these Terms and Conditions of Sale shall apply for delivery.
- 7.2 Title to any product (excluding software), and the risk of loss or damage to any product shall pass to the Customer F.O.B. destination. Customer shall obtain and pay for insurance covering such risks at destination.

8. Installation.

- 8.1 Customer shall provide Philips full and free access to the installation site and suitable and safe space for the storage of the products before installation. The products will be installed during normal working hours. Philips will unpack the product, construct applicable pads (if required for certain products), connect the product to a safety switch or breaker to be installed by the Customer, and calibrate and test the product. Customer shall provide any and all plumbing, carpentry work, conduit, wiring including communications and/or computer wiring, network equipment, power supply, surge suppression and power conditioning (except to the extent they are expressly included in the quotation), fire protection and environmental controls, ground fault and isolation system, and other fixtures and utilities required to properly attach, install, and use the product. If local labor conditions require the use of non-Philips' employees to participate in the installation of the product, then such participation of non-Philips employees shall be at Customer's expense. In such case, Philips will provide engineering supervision during the installation.
- 8.2 Customer shall be responsible, at its expense, for the preparation of the installation site where the product will be installed including any required structural alterations. The site preparation shall be in compliance with all safety, electrical, RF or magnetic shielding and acoustical suppression and building codes relevant to the product and its installation and use. The sufficiency of any installation site plans shall be the responsibility of Customer. Customer shall advise Philips of conditions at or near the site that could adversely affect the installation and shall ensure that those conditions are corrected and that the site is fully prepared and available to Philips before installation work begins. Customer, at its expense, shall obtain all permits and licenses required by federal, state, or local authorities in connection with the installation and operation of the product, including any certificate of need and zoning variances. PHILIPS MAKES NO WARRANTY AND ASSUMES NO LIABILITY FOR THE FITNESS OR ADEQUACY OF THE SITE IN WHICH THE PRODUCT IS TO BE INSTALLED OR USED.

- 8.3 Customer shall ensure, at no charge to Philips, that there are no obstacles preventing Philips from moving the product from the entrance of the Customer's premises to the installation site. Customer shall be responsible, at its expense, for rigging, the removal of partitions or other obstacles, and restoration work. Philips assumes that no hazardous materials exist at the installation site. If any such materials exist, Customer shall be responsible for the proper removal and disposal of the materials at Customer's expense.
- 8.4 Customer will (i) provide Philips with a secure location at Customer's premises to store one Philips remote services network router (or a Customer-owned router acceptable to Philips at Customer's option) for connection to the Equipment and to Customer's network; and (ii) at all times during the warranty period provide Philips with full and free access to the router and a dedicated broadband Internet access node, including but not limited to public and private interface access, suitable to establish a successful connection to the products through the Philips RSN and Customer's network for Philips' use in remote servicing of the product, remote assistance to personnel that operate the products, updating the products software, transmitting automated status notifications from the product and regular uploading of products data files(such as but not limited to error logs and utilization data for improvement of Philips products and services and aggregation into services). Customer's failure to provide such access at the scheduled time will constitute Customer's waiver of the scheduled planned maintenance service and will void support or warranty coverage of product malfunctions until such time as planned maintenance service is completed or RSN access is provided. Customer agrees to pay Philips at the prevailing demand service rates for all time spent by Philips service personnel waiting for access to the products.

9. Product Warranty.

- 9.1 If a separate product warranty page prints on this quotation, that product warranty applies to your purchase and is incorporated herein. If there isn't a separate warranty document printed on this quote, Section 9.2-9.5 applies to your purchase of that product.
- 9.2 Philips warrants to Customer that the Philips equipment (including its operating software) will perform in substantial compliance with its performance specifications in the documentation accompanying the products, for a period of 12 months beginning upon availability for first patient use. For a period of ninety (90) days from the date Philips makes Stand-alone Licensed Software available for first patient use, such Stand-alone Licensed Software shall substantially conform to the technical user manual that ships with the Stand-alone Licensed Software. "Stand-alone Licensed Software" shall mean sales of Licensed Software without a contemporaneous purchase of a server for the Licensed Software. In the event Philips is not the installer of the Stand-alone Licensed Software, the foregoing warranty period shall commence upon shipment. If the start of the installation is delayed for any reason beyond the control of Philips for more than thirty days following the date that Philips notifies Customer that the major components of the product are available for delivery, the warranty period begins on the thirty-first day following that date.
- 9.3 Philips' sole obligations and Customer's exclusive remedy under any product warranty are limited, at Philips' option, to the repair or the replacement of the product or a portion thereof, or to a refund of a portion of the purchase price paid by the Customer. Any refund will be paid to the Customer when the product is returned to Philips. Warranty service outside of normal working hours (i.e., 8:00 A.M. to 5:00 P.M., Monday through Friday, excluding Philips' observed holidays), will be subject to payment by Customer at Philips' standard service rates.
- 9.4 This warranty is subject to the following conditions: the product (a) is to be installed by authorized Philips representatives (or is to be installed in accordance with all Philips installation instructions by personnel trained by Philips), (b) is to be operated exclusively by duly qualified personnel in a safe and reasonable manner in accordance with Philips written instructions and for the purpose for which the products were intended, (c) is to be maintained and in strict compliance with all recommended and scheduled maintenance instructions provided with the product; and Customer is to notify Philips immediately in the event the product at any time fails to meet its printed performance specifications. Philips' obligations under any product warranty do not apply to any product defects resulting from improper or inadequate maintenance or calibration by the Customer or its agents; Customer or third party supplied interfaces, supplies, or software including without limitation loading of operating system patches to the Licensed Software and/or upgrades to anti-virus software (except DAT file changes) running in connection with the Licensed Software without prior validation approval by Philips; use or operation of the product other than in accordance with Philips' applicable product specifications and written instructions; abuse, negligence, accident, loss, or damage in transit; improper site preparation; unauthorized maintenance or modifications to the product; or viruses or similar software interference resulting from connection of the product to a network. Philips does not provide a warranty for any third party products furnished to Customer by Philips under the quotation; however, Philips shall use reasonable efforts to extend to Customer the third party warranty for the product. The obligations of Philips described herein and in the applicable product-specific warranty document are Philips' only obligations and Customer's sole and exclusive remedy for a breach of a product warranty.
- 9.5 THE WARRANTIES SET FORTH HEREIN AND IN PHILIPS' WARRANTY DOCUMENT WITH RESPECT TO A PRODUCT (INCLUDING THE SOFTWARE PROVIDED WITH THE PRODUCT) ARE THE ONLY WARRANTIES MADE BY PHILIPS IN CONNECTION WITH THE PRODUCT, THE SOFTWARE, AND THE TRANSACTIONS CONTEMPLATED BY THE QUOTATION, AND ARE EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, WHETHER WRITTEN, ORAL, STATUTORY, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Philips may use refurbished parts in the manufacture of the products which are subject to the same quality control procedures and warranties as for new products.

10. Philips Proprietary Service Materials. Any Philips maintenance or service software and documentation provided with the product and/or located at Customer's premises is intended solely to assist Philips and its authorized agents to install and to test the products or to assist Philips and its authorized agents to maintain and to service the products under warranty or a separate support agreement with Customer. Customer agrees to restrict access to such software and documentation to Philips' employees and those of Philips' authorized agents only.

11. Patent Infringement Claims.

- 11.1 Philips shall defend or settle any claim against Customer that a Philips product provided in the quotation infringes a valid claim under a United States patent provided that Customer:
  (i) provides Philips prompt written notice of the claim,

(ii) grants Philips full and complete information and assistance necessary for Philips to defend, settle, or avoid the claim, and (iii) gives Philips sole control of the defense or settlement of the claim.

- 11.2 The provisions of this section shall not apply in the event of any sale or other transfer of the product by Customer.
- 11.3 In the event (a) the product is found or believed by Philips to infringe such a claim, or (b) Customer has been enjoined from using the Philips product pursuant to an injunction issued by a court of competent jurisdiction, Philips may, at its option, (i) procure the right for Customer to use the product, (ii) replace or modify the product to avoid infringement, or (iii) refund to Customer a portion of the product purchase price upon the return of the original product. Philips shall have no obligation for any claim of infringement arising from: Philips' compliance with Customer's designs, specifications, or instructions; Philips' use of technical information or technology supplied by Customer; modifications to the product by Customer or its agents; use of the product other than in accordance with the product specifications or applicable written product instructions; use of the product with products not manufactured by Philips; if infringement would have been avoided by the use of a current unaltered release of the products and Philips provided Customer written notification that use of such release was mandatory; or use of the products after Philips has offered Customer one of the options described herein. The terms in this section state Philips' entire obligation and liability for claims of infringement, and Customer's sole remedy in the event of a claim of infringement.

12. Limitation of Liability. THE TOTAL LIABILITY, IF ANY, OF PHILIPS FOR ALL DAMAGES AND BASED ON ALL CLAIMS, WHETHER ARISING FROM BREACH OF CONTRACT, BREACH OF WARRANTY, NEGLIGENCE, INDEMNITY, STRICT LIABILITY OR OTHER TORT, OR OTHERWISE, ARISING FROM A PRODUCT, LICENSED SOFTWARE, AND/OR SERVICE IS LIMITED TO THE PRICE PAID HEREUNDER FOR THE PRODUCT, LICENSED SOFTWARE, OR SERVICE. THIS LIMITATION SHALL NOT APPLY TO THIRD PARTY CLAIMS FOR BODILY INJURY OR DEATH CAUSED BY PHILIP'S NEGLIGENCE OR PROVEN PRODUCT DEFECT.

13. DISCLAIMER. IN NO EVENT SHALL PHILIPS BE LIABLE FOR ANY INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR SPECIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR PROFITS, BUSINESS INTERRUPTION, LOSS OF DATA, OR THE COST OF SUBSTITUTE PRODUCTS OR SERVICES WHETHER ARISING FROM BREACH OF CONTRACT, BREACH OF WARRANTY, NEGLIGENCE, INDEMNITY, STRICT LIABILITY OR OTHER TORT.

14. Confidentiality. Each party shall maintain as confidential any information furnished or disclosed to one party by the other party, whether disclosed in writing or disclosed orally, relating to the business of the disclosing party, its customers and/or its patients, and the quotation and its terms, including the pricing terms under which Customer has agreed to purchase the products. Each party shall use the same degree of care to protect the confidentiality of the disclosed information as that party uses to protect the confidentiality of its own information, but in no event less than a reasonable amount of care. Each party shall disclose such confidential information only to its employees having a need to know such information to perform the transactions contemplated by the quotation. The obligation to maintain the confidentiality of such information shall not extend to information in the public domain at the time of disclosure, and/or information that is required to be disclosed by law or by court order.

15. Compliance with Laws & Privacy. Each party shall comply with all laws, rules, and regulations applicable to the party in connection with the performance of its obligations in connection with the transactions contemplated by the quotation, including, but not limited to, those relating to affirmative action, fair employment practices, FDA, Medicare fraud and abuse, and the Health Insurance Portability and Accountability Act of 1996 ("HIPAA"). Health care providers are reminded that if the purchase includes a discount or loan, they must fully and accurately report such discount or loan on cost reports or other applicable claims for payment submitted under any federal or state health care program, including but not limited to Medicare and Medicaid, as required by federal law (see 42 CFR 1001.952[h]).

In the course of providing project implementation related services and/or warranty services to Customer, hereunder, it may be necessary for Philips to have access to, view and/or download computer files from the products that might contain Personal Data. "Personal Data" shall mean information relating to an individual, from which that individual can be directly or indirectly identified. Personal Data can include both personal health information (e.g., images, heart monitor data, medical record number) and non-health information (e.g., date of birth, gender). Philips will process Personal Data only to the extent necessary to perform and/or fulfill its project implementation related service, warranty service and/or warranty obligations hereunder.

16. General Terms. The following additional terms shall be applicable to the purchase of a product:

- 16.1 **Force Majeure.** Each party shall be excused from performing its obligations (except for payment obligation) arising from any delay or default caused by events beyond its reasonable control including, but not limited to, acts of God, acts of third parties, acts of any civil or military authority, fire, floods, war, embargoes, labor disputes, acts of sabotage, riots, accidents, delays of carriers, subcontractors or suppliers, voluntary or mandatory compliance with any government act, regulation or request, shortage of labor, materials or manufacturing facilities.
- 16.2 **Bankruptcy.** If Customer becomes insolvent, is unable to pay its debts when due, files for bankruptcy, is the subject of involuntary bankruptcy, has a receiver appointed, or has its assets assigned, Philips may cancel any unfulfilled obligations, or suspend performance; however, Customer's financial obligations to Philips shall remain in effect.
- 16.3 **Assignment.** Customer may not assign any rights or obligations in connection with the transactions contemplated by the quotation without the prior written consent of Philips, which consent shall not be unreasonably withheld, and any attempted assignment without such consent shall be of no force or effect.
- 16.4 **Export.** Customer shall assume sole responsibility for obtaining any required export authorizations in connection with Customer's export of the products from the country of delivery.
- 16.5 **Governing Law.** All transactions contemplated by the quotation shall be governed by the laws of the state where the equipment will be installed, without regard to that state's choice of law principles, and expressly excluding application of the Uniform Computer Information Transactions Act (" UCITA"), in any form.
- 16.6 **Entire Agreement.** These Terms and Conditions of Sale, the terms and conditions set forth in the quotation and the applicable Philips' product-specific warranty document constitute the entire understanding and agreement by and between the parties with respect to the transactions contemplated by the quotation, and supersede any previous understandings or agreements between the parties, whether written or oral, regarding the transactions contemplated by the quotation. The pricing in the quotation is based upon the terms and conditions in the quotation. No additional terms, conditions, consents, waivers, alterations, or modifications shall be binding unless in writing and signed by the parties. Customer's additional or different terms

and conditions, whether stated in a purchase order or other document issued by Customer, are specifically rejected and shall not apply to the transactions contemplated by the quotation.

- 16.7 **Headings.** The headings in the quotation are intended for convenience only and shall not be used to interpret the quotation.
- 16.8 **Severability.** If any provision of the quotation is deemed to be illegal, unenforceable, or invalid, in whole or in part, the validity and enforceability of the remaining provisions shall not be affected or impaired, and shall continue in full force and effect.
- 16.9 **Notices.** Notices or other communications shall be in writing, and shall be deemed served if delivered personally, or if sent by facsimile transmission, by overnight mail or courier, or by certified mail, return receipt requested and addressed to the party at the address set forth in the quotation.
- 16.10 **Performance.** The failure of Customer or of Philips at any time to require the performance of any obligation will not affect the right to require such performance at any time thereafter. Course of dealing, course of performance, course of conduct, prior dealings, usage of trade, community standards, industry standards, and customary standards and customary practice or interpretation in matters involving the sale, delivery, installation, use, or service of similar or dissimilar products or services shall not serve as references in interpreting the terms and conditions of the quotation.
- 16.11 **Obligations.** Customer's obligations are independent of any other obligations the Customer may have under any other agreement, contract, or account with Philips. Customer will not exercise any right of offset in connection with the terms and conditions in the quotation or in connection with any other agreement, contract, or account with Philips.
- 16.12 **Additional Terms.** Schedule 1 is incorporated herein and its additional terms shall apply solely to Customer's purchase of X-Ray, Computed Tomography, Magnetic Resonance, Nuclear Medicine and Ultrasound products (including Image Guided Intervention and Therapy (IGIT) products). In the event any terms set forth in a schedule conflict with terms set forth in these Terms and Conditions of Sale, the terms set forth in the schedule shall govern.

OPERATING SOFTWARE LICENSE

1. License Grant
   - 1.1 Subject to any usage limitations for the Licensed Software set forth on the product description of the quotation, Philips grants to Customer a nonexclusive and non- transferable right and license to use the computer software package (the "Licensed Software") in accordance with the terms of the quotation. The License shall continue for as long as Customer continues to own the product, except that Philips may terminate the License in the event of any breach or default by Customer. Customer shall return the Licensed Software and any authorized copies thereof to Philips immediately upon expiration or termination of this License.
   - 1.2 The License does not include any right to use the Licensed Software for purposes other than the operation of the product. Customer may make one copy of the Licensed Software in machine-readable form solely for backup purposes. Otherwise, except as otherwise provided under section 1.6, Customer may not copy, reproduce, sell, assign, transfer, or sublicense the Licensed Software for any purpose without the prior written consent of Philips. Customer shall reproduce Philips' copyright notice or other identifying legends on such copies or reproductions. Customer will not (and will not allow any third party to) decompile, disassemble, or otherwise reverse engineer or attempt to reconstruct or discover the product or Licensed Software by any means whatsoever.
   - 1.3 The License shall not affect the exclusive ownership by Philips of the Licensed Software or of any trademarks, copyrights, patents, trade secrets, or other intellectual property rights of Philips (or any of Philips' suppliers) relating to the Licensed Software.
   - 1.4 Customer agrees that only authorized officers, employees, and agents of Customer will use the Licensed Software or have access to the Licensed Software (or to any part thereof), and that none of Customer's officers, employees, or agents will disclose the Licensed Software, or any portion thereof, or permit the Licensed Software, or any portion thereof, to be used by any person or entity other than those entities identified on the quotation. Customer acknowledges that certain of Philips' rights may be derived from license agreements with third parties, and Customer agrees to preserve the confidentiality of information provided by Philips under such third party license agreements.
   - 1.5 The Licensed Software shall be used only on the product(s) referenced in the quotation.
   - 1.6 Customer may transfer the Licensed Software in connection with sale of the product to a healthcare provider who accepts all of the terms and conditions of this License; provided that Customer is not in breach or default of this License, the Terms and Conditions of Sale, or any payment obligations to Philips.

2. Modifications
   - 2.1 If Customer modifies the Licensed Software in any manner, all warranties associated with the Licensed Software and the products shall become null and void. If Customer or any of its officers, employees, or agents should devise any revisions, enhancements, additions, modifications, or improvements in the Licensed Software, Customer shall disclose them to Philips, and Philips shall have a non-exclusive royalty-free license to use and to sub-license them.
   - 2.2 The Licensed Software is licensed to Customer on the basis that (i) Customer shall maintain the configuration of the products as they were originally designed and manufactured and (ii) the product includes only those subsystems and components certified by Philips. The Licensed Software may not perform as intended on systems modified by other than Philips or its authorized agents, or on systems which include subsystems or components not certified by Philips. Philips does not assume any responsibility or liability with respect to unauthorized modification or substitution of subsystems or components.

3. Open Source
   - 3.1 Customer's rights under this License are conditioned upon Customer not performing, and Customer shall not perform, any actions in a manner that would require any software furnished with the product, or the product and/or any derivative work thereof, to be licensed under Open License Terms. These actions include but are not limited to:
     (i) combining such software, the product or a derivative work thereof with Open Source Software by means of incorporation,

linking or otherwise; or
(ii) distributing such software, the product or a derivative work thereof with Open Source Software; or
(iii) using Open Source Software to create a derivative work of the product or such software, insofar as these actions would require such software, the product or a derivative work thereof to be licensed under Open License Terms.

- 3.2 As used herein, "Open Source Software" means any software that is licensed under Open License Terms. "Open License Terms" means terms in any license agreement or grant that requires as a condition of use, modification and/or distribution of a work that:
  (i) source code will be made available, or
  (ii) permission will be granted for creating derivative works, or
  (iii) a royalty-free license be granted to any party under any intellectual property right regarding that work and/or any other work that contains, is combined with, requires or is based on that work.
- 3.3 Customer shall indemnify Philips and its affiliates against and hold Philips and its affiliates harmless from any damage or costs arising from or in connection with any violation or breach of the provisions of this Section 3, and Customer shall reimburse all costs and expenses incurred by Philips and/or its affiliates in defending any claim, demand, suit or proceeding arising from or in connection with such violation or breach.

10/08 Printed in U.S.A.

Schedule 1
General X-Ray, Computed Tomography (CT), Magnetic Resonance (MR), Cardiovascular (CV), Positron Emission Tomography (PET), Nuclear Medicine (NM), and Ultrasound products (including IGIT Products)

1. Payment Terms. Unless otherwise specified in the quotation, Philips will invoice Customer, and Customer will immediately pay such invoice on receipt, as follows
(a) For X-Ray, Computed Tomography, Magnetic Resonance, and Nuclear Medicine products:
(i) 10% of the purchase price shall be due with Customer's acceptance of the quotation.
(ii) 70% of the purchase price shall be due on delivery of the major components of the product. Product installation will not begin until Customer has paid this portion of the purchase price.
(iii) 20% of the purchase price shall be due when the product is available for first patient use. Available for first patient use means the product has been installed and substantially meets Philips' published specifications. If the start of the installation is delayed for any reason beyond the control of Philips for more than thirty days following the date that Philips notifies Customer that the major components of the product are available for delivery, the unpaid portion of the purchase price shall be due on the thirty-first day following such date.

(b) For Ultrasound products (including IGIT Products):
100% of the purchase price shall be due thirty days from Philips' invoice date.

2. Cancellation.
(a) All schedule 1 Products, except Ultrasound. The quotation is subject to change or withdrawal prior to written acceptance by Customer. All purchase orders issued by Customer are subject to acceptance by Philips. If Customer cancels an order prior to product delivery, Customer shall pay a cancellation charge of fifteen percent (15%) of the net order price. Orders are non-cancellable for products delivered.
(b) Ultrasound. The quotation is subject to change or withdrawal prior to written acceptance by Customer. All purchase orders issued by Customer are subject to acceptance by Philips. If Customer cancels an order after an ultrasound product has shipped, Customer shall pay a cancellation charge of fifteen percent (15%) of the net order price for the product cancelled.

3. Delivery.

- 3.1 Philips will use reasonable efforts to ship the product to the Customer by the (i) mutually agreed upon shipment date, or (ii) by the date stated in the quotation, or (iii) as otherwise agreed in writing. Philips will ship the product according to Philips' standard commercial practices. Philips may make partial shipments. Philips will pay shipping costs associated with product shipment. Prior to the shipment of any product, Philips may change the construction or the design of the product without notice to the Customer so long as the function, footprint, and performance of the product are not substantially altered.
- 3.2 If Customer requests a delay in the date major components of the product are available for delivery, then Philips will place the product in storage and the unpaid portion of the purchase price shall be due. Customer will reimburse Philips for all storage fees incurred upon receipt of invoice.

4. Additional Customer Installation obligations for Magnetic Resonance. Customer, Customer's contractor, or Customer's architect is required to provide detailed information on the proposed Helium Exhaust Pipe for their MRI system prior to installation to ensure safety specifications are being met.
Required Details include:
- Architectural drawing or sketch with complete dimensions including lengths, bending radii, bending angles, and pipe diameters for entire Helium Exhaust Pipe run from RF enclosure to discharge location.
- Completed Helium Exhaust Pipe Verification Checklist (Provided by Local PHILIPS Project Manager)
- Picture showing the area where the Helium Exhaust Pipe will discharge.
Magnets will not be released for delivery unless and until Helium Exhaust Pipe details are provided for verification and have been confirmed to meet all life safety specifications.

5. Additional Terms Related to Sales of IGIT products
(a) As part of installation, Philips will connect the IGIT product to such DICOM compatible scanners as Customer may designate (in writing), including CT and MR scanners and, if ultrasound navigation is included in the product, an iU22 ultrasound system.
(b) If Customer requires that Philips connect the IGIT product to more than two (2) scanners or other devices, then Philips shall invoice Customer (and Customer shall pay) for installation services (at Philips's then-current daily service rate)
(c) Philips warrants to Customer that Tools purchased concurrently with the IGIT product (other than consumables) will perform in substantial compliance with the performance specification laid out in user documentation specific to the Tool for a thirty (30) day period starting from the shipment date. Philips warrants to Customer that Tools (other than consumables) that Customer purchases subsequently to its initial purchase of the IGIT product will perform in substantial compliance with the performance specifications laid out in user documentation specific to the Tool for a thirty (30) day period following the date of delivery of such Tools. "Tools" means tools certified by Philips as components of or accessories for the IGIT product, whether included in the initial order as set out in the Quotation or separately and, in each case, includes dynamic references, instruments, and pointers.
(d) Training on the IGIT product is not included with the purchase of the IGIT product unless it is separately identified on the quotation.

PHILIPS PRODUCT WARRANTY

COMPUTED TOMOGRAPHY (CT) SYSTEMS

This product warranty document is an addition to the terms and conditions set forth in the quotation to which this warranty document is attached. The terms and conditions of the quotation are incorporated into this warranty document. The capitalized terms herein have the same meaning as set forth in the quotation.

TWELVE (12) MONTH SYSTEM WARRANTY
Philips warrants to Customer that the Philips CT System (the "System") will be free from defects in material and manufacturing workmanship for a period of twelve (12) months after completion of installation or availability for patient use, whichever occurs first. If an X-ray tube, Chiller Unit, Power Conditioner Unit, CT Injector Unit, Option, Upgrade or Accessory is purchased from Philips, they will be covered by the special warranty set forth below.

PLANNED MAINTENANCE
During the warranty period, Philips service personnel will schedule planned maintenance visits, in advance, at a mutually agreeable time on weekdays, between 8:00 A.M. and 5:00 P.M., excluding Philips observed holidays.

SYSTEM OPTIONS, UPGRADES OR ACCESSORIES
Any commercially available options, upgrades, or accessories for the System which are delivered and/or installed on the System during the original term of the System warranty shall be subject to the same warranty terms contained in the first paragraph of this warranty, except that such warranty shall expire on the later of: a) upon termination of the initial twelve (12) month warranty period for the System on which the option, upgrade or accessory is installed, b) after ninety (90) days for parts only from the date of installation. Any commercially available options, upgrades, or accessories for the System which are delivered and/or installed on the System after the original term of the System warranty has expired shall be subject to the same warranty terms contained in the first paragraph of this warranty, except that such warranty shall expire the later of: a) after ninety (90) days for parts only from the date of installation, or b) on the twelve (12) month renewal date of any current service agreement then in effect on the System.

X-RAY TUBE WARRANTY BRILLIANCE CT
SERIES -MRC X-RAY TUBES:
The CT MRC X-ray Tube ("tube") warranty period is for twelve (12) months from the date of installation or availability for patient use, whichever occurs first. If a tube becomes inoperative or fails when operated within this twelve (12) month warranty period, upon return of the tube, Philips will provide a replacement tube at no additional charge. The replacement tube will be warranted for the balance of the original twelve (12) month warranty.

BRILLIANCE CT SERIES & MX8000 CT SERIES – AKRON OR CTR2112/ CTR2150 X-RAY TUBES:
The CT X-ray Tube ("Tube") warranty period is the shorter of twelve (12) months from the date of installation or 120,000 scan-seconds. If a tube becomes inoperative or fails when operated within published ratings, upon return of the tube, a prorated credit toward the purchase of a replacement tube from Philips will be issued as follows: Failure within the first 3,000 Scan-Seconds = 100% credit will be provided. Failure after the first 3,000 Scan-Seconds = tube credit will be prorated (See CT X-ray Tube Credit Proration Calculation below). Scan-Seconds are the number of seconds the System operates with the X-ray on.

Brilliance CT Series & Mx8000 CT Series X-Ray Tube Credit Proration Calculation:

$$\text{Credit} = 1 - \frac{\text{Number of Scan-Seconds Used}}{120{,}000}$$

Expressed in a percentage not to exceed 100%.

ACQSIM CT, PQ2000S OR ULTRA-Z CT X-RAY TUBES
The CT X-ray Tube ("Tube") warranty period is the shorter of twelve (12) months from the date of installation or 100,000 exposures. If a tube becomes inoperative or fails when operated within published ratings, upon return of the tube a prorated credit toward the purchase of a replacement tube will be issued as follows: Failure within the first 3,000 exposures = 100% credit will be provided. Failure after the first 3,000 exposures = tube credit will be prorated (See CT X-ray Tube Credit Proration Calculation below). An Exposure is any 360 degree or partial angle rotation of the gantry scan frame with the X-ray on.

ACQSIM CT, PQ2000s or ULTRA-Z CT X-ray Tube Credit Proration Calculation:

$$\text{Credit} = 1 - \frac{\text{Number of Exposures Made}}{100{,}000}$$

Expressed in a percentage not to exceed 100%.

All claims under this Tube warranty must be made within sixty (60) days of failure, or fourteen (14) months of (1) the date of installation (if installation of the tube is performed by Philips) or (2) the delivery (if installation of the tube is not performed by Philips), which ever comes first.

CHILLER UNIT, POWER CONDITIONER UNIT OR INJECTOR UNIT WARRANTY
The System can be purchased with an optional Chiller Unit, Power Conditioner Unit or Injector Unit. If any of these Units are purchased with the System, Philips will include these Units under the twelve (12) month System warranty as an OEM Warranty pass through. Authorized representatives of the Original Equipment Manufacturer will perform warranty service on each of these units.

SYSTEM SOFTWARE AND SOFTWARE UPDATES
The software provided with the System will be the latest version of the standard software available for that system as of the 90th day prior to the date the System is delivered to Customer. Updates to standard software for the System that do not require additional hardware or equipment modifications will be performed as a part of normal warranty service during the term of the warranty. "Updates" shall mean changes to the right of the decimal point for the software shipped with the product

All software is and shall remain the sole property of Philips or its software suppliers. Use of the software is subject to the terms of a separate software license agreement. Customer must sign all such license agreements prior to or upon the delivery of the product. No license or other right is granted to Customer or to any other party to use the software except as set forth in the license agreements.

Any Philips maintenance or service software and documentation provided with the product and/or located at Customer's premises is intended solely to assist Philips and its authorized agents to install and to test the System, to assist Philips and its authorized agents to maintain and to service the System under a separate support agreement with Customer, or to permit Customer to maintain and service the System. Customer agrees to restrict the access to such software and documentation to Philips' employees and those of its authorized agents, and to authorized employees of Customer only.

WARRANTY LIMITATIONS
Philips' obligations under the System warranty are limited, at Philips' option, to the repair or the replacement of the System or a portion thereof, or to a credit or refund of a portion of the purchase price paid by Customer. Any refund will be paid to Customer when the System is returned to Philips. Certain of the parts used in the manufacture or installation of, or in the replacement parts for, this System may contain refurbished components. If such components are used, they will be subject to the same quality control and inspection procedures as new components. Any System warranty is made on condition that Philips receives written notice of a System defect during the warranty period, and within thirty (30) days following the discovery of the defect by Customer. Philips' obligations under the System warranty do not apply to any System defects resulting from: improper or inadequate maintenance or calibration by Customer or its agents; Customer or third party supplied software, interfaces, or supplies; use or operation of the product other than in accordance with loss, or damage in transit; improper site preparation; operation of the system outside its environmental, electrical, or performance specifications; unauthorized maintenance or Philips' applicable product specifications and written instructions; abuse, negligence, accident, modifications to the System; or to viruses or similar software interference resulting from the connection of the product to a network. Philips does not provide a warranty for any such third party products furnished to Customer by Philips; however, Philips shall use reasonable efforts to extend to Customer the third party warranty for the product. The obligations of Philips described above are Philips' only obligations and Customer's sole and exclusive remedy for a breach of a System warranty. Repairs or replacement parts do not extend the term of this warranty.

THE WARRANTIES SET FORTH IN PHILIPS' WARRANTY DOCUMENT WITH RESPECT TO THIS SYSTEM (INCLUDING THE SOFTWARE PROVIDED WITH THE SYSTEM) ARE THE ONLY WARRANTIES MADE BY PHILIPS IN CONNECTION WITH THE SYSTEM, THE SOFTWARE, AND THE TRANSACTIONS CONTEMPLATED BY THE QUOTATION, AND ARE EXPRESSLY IN LIEU OF ANY OTHER WARRANTIES, EXPRESS OR IMPLIED INCLUDING, WITHOUT LIMITATION, ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

ACCESS TO SYSTEM
Philips shall have full, free and safe access to the System and Customer's operation, performance and maintenance records for the System, on each scheduled or requested warranty service visit. Philips shall also have access to and use of any machine, service, attachment, features or other equipment required to perform the necessary service contemplated herein at no charge to Philips. Customer waives warranty service if it does not provide such access to the System and Customer's records. Should Philips be denied access to the

System and Customer's records at the agreed upon time, a charge equal to the appropriate hourly rate will be accepted by Customer for "waiting time."

WARRANTY SERVICE
In the event it is not possible to accomplish warranty service within normal working hours (8:00 A.M. to 5:00 P.M., Monday through Friday, excluding Philips observed holidays), or in the event Customer specifically requests that warranty service be performed outside of Philips normal working hours, Customer agrees to pay for such services at Philips standard service rates in effect. Customer Support Agreements are available for extended coverage.

TRANSFER OF SYSTEM
In the event Customer transfers or relocates the System, all obligations under this warranty will terminate unless Customer receives the prior written consent of Philips for the transfer or relocation. Upon any transfer or relocation, the System must be inspected and certified by Philips as being free from all defects in material, software and workmanship and as being in compliance with all technical and performance specifications. Customer will compensate Philips for these services at the prevailing service rates in effect as of the date the inspection is performed. Any System, which is transported intact to pre-approved locations and is maintained as originally installed in mobile configurations, will remain covered by this warranty.

CONDITIONS
This warranty is subject to the following conditions: the System (a) is to be installed by authorized Philips representatives (or is to be installed in accordance with all Philips installation instructions by personnel trained by Philips), (b) is to be operated exclusively by duly qualified personnel in a safe and reasonable manner in accordance with Philips written instructions and for the purpose for which the products were intended, (c) is to be maintained and in strict compliance with all recommended and scheduled maintenance instructions provided with the System, and (d) Customer is to notify Philips immediately in the event the System at any time fails to meet its printed performance specifications.

LIMITATIONS OF LIABILITY AND DISCLAIMERS
The liability, if any, of Philips for damages whether arising from breach of the terms in the quotation, breach of warranty, negligence, indemnity, strict liability or other tort, or otherwise with respect to the products and services is limited to an amount not to exceed the price of the product or service giving rise to the liability.

IN NO EVENT SHALL PHILIPS BE LIABLE FOR ANY INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR SPECIAL DAMAGES, INCLUDING WITHOUT LIMITATION, LOST REVENUES OR PROFITS, OR THE COST OF SUBSTITUTE PRODUCTS OR SERVICES WHETHER ARISING FROM BREACH OF THE TERMS IN THIS QUOTATION, BREACH OF WARRANTY, NEGLIGENCE, INDEMNITY, STRICT LIABILITY OR OTHER TORT. PHILIPS SHALL HAVE NO LIABILITY FOR ANY GRATUITOUS ADVICE PROVIDED TO THE CUSTOMER.

FORCE MAJEURE
Philips and Customer shall each be excused from performing its obligations arising from any delay or default caused by events beyond its reasonable control including, but not limited to: acts of God, acts of third parties, acts of the other party, acts of any civil or military authority, fire, floods, war, embargoes, labor disputes, acts of sabotage, riots, accidents, delays of carriers, subcontractors or suppliers, voluntary or mandatory compliance with any government act, regulation or request, shortage of labor, materials or manufacturing facilities.

Philips Medical Systems System specificationsare subject to change without notice Document Number 4535 983 03551 999

Exhibit 8

11. C (i). Please provide one year of actual results and three years of projections of **Total Facility** revenue, expense and volume statistics without, incremental to and with the CON proposal in the following reporting format:

Total Facility: Description	FY 2009 Actual Results	FY 2010 Projected W/out CON	FY 2010 Projected Incremental	FY 2010 Projected With CON	FY 2011 Projected W/out CON	FY 2011 Projected Incremental	FY 2011 Projected With CON	FY 2012 Projected W/out CON	FY 2012 Projected Incremental	FY 2012 Projected With CON
NET PATIENT REVENUE										
Non-Government	$188,335	$195,471		$195,471	$215,816		$215,816	$222,316	$13	$222,329
Medicare	$75,090	$73,942		$73,942	$79,577		$79,577	$81,463		$81,463
Medicaid and Other Medical Assistance	$6,821	$8,768		$8,768	$9,732		$9,732	$9,834		$9,834
Other Government				$0			$0			$0
Total Net Patient Patient Revenue	$270,246	$278,181	$0	$278,181	$305,125	$0	$305,125	$313,613	$13	$313,626
Other Operating Revenue	$23,861	$21,725		$21,725	$19,234		$19,234	$19,601		$19,601
Revenue from Operations	$294,107	$299,906	$0	$299,906	$324,359	$0	$324,359	$333,214	$13	$333,227
OPERATING EXPENSES										
Salaries and Fringe Benefits	$156,642	$154,802		$154,802	$169,763		$169,763	$174,856		$174,856
Professional / Contracted Services	$32,564	$31,339		$31,339	$36,002		$36,002	$37,082		$37,082
Supplies and Drugs	$39,477	$43,693		$43,693	$48,290		$48,290	$49,739		$49,739
Bad Debts	$7,851	$8,292		$8,292	$9,148		$9,148	$9,422		$9,422
Other Operating Expense	$20,976	$22,582		$22,582	$24,251		$24,251	$24,979	($47)	$24,932
Subtotal	$257,510	$260,708	$0	$260,708	$287,454	$0	$287,454	$296,078	($47)	$296,031
Depreciation/Amortization	$19,015	$19,898		$19,898	$21,929		$21,929	$22,587	$127	$22,714
Interest Expense	$669	$439		$439	$463		$463	$477		$477
Lease Expense	$6,338	$6,452		$6,452	$7,167		$7,167	$7,382		$7,382
Total Operating Expense	$283,532	$287,497	$0	$287,497	$317,013	$0	$317,013	$326,523	$80	$326,603
Gain/(Loss) from Operations	$10,575	$12,409	$0	$12,409	$7,346	$0	$7,346	$6,691	($67)	$6,624
Plus: Non-Operating Revenue	($1,092)	($2,993)		($2,993)	($643)		($643)	($662)		($662)
Revenue Over/(Under) Expense	$9,483	$9,416	$0	$9,416	$6,703	$0	$6,703	$6,028	($67)	$5,961
FTEs	1609	1570		1570	1638		1638	1646		1646
*Volume Statistics:								116	43	159

Provide projected inpatient and/or outpatient statistics for any new services and provide actual and projected inpatient and/or outpatient statistics for any existing services which will change due to the prop

11. C (i). Please provide one year without, incremental to a

Total Facility: / Description	FY 2013 Projected W/out CON	FY 2013 Projected Incremental	FY 2013 Projected With CON	FY 2014 Projected W/out CON	FY 2014 Projected Incremental	FY 2014 Projected With CON
NET PATIENT REVENUE						
Non-Government	$229,270	$14	$229,284	$236,721	$14	$236,735
Medicare	$83,453		$83,453	$85,632		$85,632
Medicaid and Other Medical Assistance	$9,943		$9,943	$10,061		$10,061
Other Government			$0			$0
Total Net Patient Patient Revenue	$322,666	$14	$322,680	$332,414	$14	$332,428
Other Operating Revenue	$19,800		$19,800	$20,001		$20,001
Revenue from Operations	$342,466	$14	$342,480	$352,415	$14	$352,429
OPERATING EXPENSES						
Salaries and Fringe Benefits	$180,102		$180,102	$185,505		$185,505
Professional / Contracted Services	$38,195		$38,195	$39,340		$39,340
Supplies and Drugs	$51,231		$51,231	$52,768		$52,768
Bad Debts	$9,705		$9,705	$9,996		$9,996
Other Operating Expense	$25,728	$43	$25,771	$26,500	$43	$26,543
Subtotal	$304,960	$43	$305,003	$314,109	$43	$314,152
Depreciation/Amortization	$23,264	$251	$23,515	$23,962	$251	$24,213
Interest Expense	$491		$491	$506		$506
Lease Expense	$7,603		$7,603	$7,832		$7,832
Total Operating Expense	$336,319	$294	$336,613	$346,409	$294	$346,703
Gain/(Loss) from Operations	$6,147	($280)	$5,867	$6,006	($280)	$5,726
Plus: Non-Operating Revenue	($682)		($682)	($703)		($703)
Revenue Over/(Under) Expense	$5,465	($280)	$5,185	$5,304	($280)	$5,024
FTEs	1654		1654	1663		1663
*Volume Statistics: Provide projected inpatient and/or outpatient osal.	118	44	162	120	45	165

Exhibit 9

Please provide **three** years of projections of incremental revenue, expense and volume statistics **attributable to the proposal** in the following reporting format:

Type of Service Description	CT Simulator									
Type of Unit Description:	procedure									
# of Months in Operation	12									
FY _2012__	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FY Projected Incremental		Rate	Units	Gross	Allowances/	Charity	Bad	Net	Operating	Gain/(Loss)
Total Incremental Expenses:	**$80,000**			Revenue	Deductions	Care	Debt	Revenue	Expenses	from Operations
				Col. 2 * Col. 3				Col.4 - Col.5	Col. 1 Total *	Col. 8 - Col. 9
Total Facility by								-Col.6 - Col.7	Col. 4 / Col. 4 Total	
Payer Category:										
Medicare		$1,848	19	$35,112	$35,112			$0	$35,349	($35,349)
Medicaid		$1,848	0	$0	$0			$0	$0	$0
CHAMPUS/TriCare		$1,848		$0				$0	$0	$0
Total Governmental			19	$35,112	$35,112	$0	$0	$0	$35,349	($35,349)
Commericial Insurers		$1,848	23	$42,504	$31,028			$11,476	$42,791	($31,315)
Uninsured		$1,848	1	$1,848	$277			$1,571	$1,860	($290)
Total NonGovernment		$1,848	24	$44,352	$31,305	$0	$0	$13,047	$44,651	($31,604)
Total All Payers		$1,848	43	$79,464	$66,417	$0	$0	$13,047	$80,000	($66,953)

Please provide **three** years of projections of incremental revenue, expense and volume statistics **attributable to the proposal** in the following reporting format:

Type of Service Description	CT Simulator
Type of Unit Description:	procedure
# of Months in Operation	12

FY _____	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FY Projected Incremental		Rate	Units	Gross	Allowances/	Charity	Bad	Net	Operating	Gain/(Loss)
Total Incremental Expenses:	**$294,000**			Revenue	Deductions	Care	Debt	Revenue	Expenses	from Operations
				Col. 2 * Col. 3				Col.4 - Col.5	Col. 1 Total *	Col. 8 - Col. 9
Total Facility by								-Col.6 - Col.7	Col. 4 / Col. 4 Total	
Payer Category:										
Medicare		$1,903	19	$36,165	$36,165			$0	$126,955	($126,955)
Medicaid		$1,903	0	$0	$0			$0	$0	$0
CHAMPUS/TriCare		$1,903		$0				$0	$0	$0
Total Governmental			19	$36,165	$36,165	$0	$0	$0	$126,955	($126,955)
Commericial Insurers		$1,903	24	$45,683	$33,348			$12,334	$160,364	($148,029)
Uninsured		$1,903	1	$1,903	$286			$1,618	$6,682	($5,064)
Total NonGovernment		$1,903	25	$47,586	$33,634	$0	$0	$13,952	$167,045	($153,093)
Total All Payers		$1,903	44	$83,751	$69,799	$0	$0	$13,952	$294,000	($280,048)

Please provide **three** years of projections of incremental revenue, expense and volume statistics **attributable to the proposal** in the following reporting format:

Type of Service Description	CT Simulator									
Type of Unit Description:	procedure									
# of Months in Operation	12									
FY _____	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
FY Projected Incremental		Rate	Units	Gross	Allowances/	Charity	Bad	Net	Operating	Gain/(Loss)
Total Incremental Expenses:	**$294,000**			Revenue	Deductions	Care	Debt	Revenue	Expenses	from Operations
				Col. 2 * Col. 3				Col.4 - Col.5	Col. 1 Total *	Col. 8 - Col. 9
Total Facility by								-Col.6 - Col.7	Col. 4 / Col. 4 Total	
Payer Category:										
Medicare		$1,961	20	$39,211	$39,211			$0	$130,667	($130,667)
Medicaid		$1,961	0	$0	$0			$0	$0	$0
CHAMPUS/TriCare		$1,961		$0				$0	$0	$0
Total Governmental			20	$39,211	$39,211	$0	$0	$0	$130,667	($130,667)
Commericial Insurers		$1,961	24	$47,053	$34,349			$12,704	$156,800	($144,096)
Uninsured		$1,961	1	$1,961	$294			$1,666	$6,533	($4,867)
Total NonGovernment		$1,961	25	$49,014	$34,643	$0	$0	$14,371	$163,333	($148,963)
Total All Payers		$1,961	45	$88,224	$73,854	$0	$0	$14,371	$294,000	($279,629)

Exhibit 10

Greenwich Hospital
Acquisition of a CT Simulator
Docket # 10-31647
Assumptions

Revenue

Operational date is assumed 10/01/11

The outpatient payer mix of the current patients receiving simulations is applied.

The gross charge and revenue for CPT 77014 is applied

Expenses

There are no additional FTE's required

Service contract expense is effective starting one year after operational effective date 10/01/12 and is a net number comprised of $90,000 expense for the new CT Simulator less the service contract on the current simulator

Depreciation on the CT Simulator is calculated at a 5 year useful life.
Depreciation on the construction is calculated at 40 years

Greenwich Hospital
Acquisition of a CT Simulator
Docket # 10-31647
Depreciation Schedule

Exhibit 10

Capital Expendiure

Equipment	$	1,248,301
Life years		5
Year 1		124,830
Year 2		249,660
Year 3		249,660
Year 4		249,660
Year 5		249,660
Year 6		124,830
Total		1,248,301

Total Construct/Renovation	$	71,900
Life years		40
Year 1		1,798
Year 2		1,798
Year 3		1,798
Year 4		1,798
Year 5		1,798
Year 6		1,798
Year 7		1,798
Year 8		1,798
Year 9		1,798
Year 10		1,798
Year 11		1,798
Year 12		1,798
Year 13		1,798
Year 14		1,798
Year 15		1,798
Year 16		1,798
Year 17		1,798
Year 18		1,798
Year 19		1,798
Year 20		1,798
Year 21		1,798
Year 22		1,798
Year 23		1,798
Year 24		1,798
Year 25		1,798
Year 26		1,798
Year 27		1,798
Year 28		1,798
Year 29		1,798
Year 30		1,798
Year 31		1,798
Year 32		1,798
Year 33		1,798
Year 34		1,798
Year 35		1,798
Year 36		1,798
Year 37		1,798
Year 38		1,798
Year 39		1,798
Year 40		1,798
Total		71,900

Total	$	1,320,201
Year 1		126,628
Year 2		251,458
Year 3		251,458
Year 4		251,458

* Per hospital policy half a year depreciation in year 1 for equipment