Economic Impact of IMRT
with modest socio-economic comments

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Intensity-Modulated Radiation Therapy: The Inverse, the Converse, and the Perverse
Eli Gladstein, M.D.

- Seminars in Radiation Oncology, Vol 12. No 3 (July) 2002
- "The present euphoria surrounding IMRT is difficult to dissect. IMRT has been heavily touted by both vendors and investigators, although actual clinical data for analysis have so far been sparse."

The Inverse, the Converse, and the Perverse
Eli Gladstein, M.D.

- Cost Considerations Negative
- "It should be obvious to all that IMRT is expensive in terms of (1) the space, hardware, and software that are required; (2) the time involved in preparation of plans and execution of treatment; (3) the manpower available to carry out such planning and treatment; and (4) the expenditures that go along with all of those resources."

Health Care Costs
2000 Consumers Union

- 1996 7.9% of household income was spent on health care
- 2000 8.6% of household income was spent on health care
- 44 million uninsured
- In 1998 18.4% of the people under 65 years old were uninsured.

Health Care Costs

- NCI estimated that in 1994 cancer care represented 5% of all health care costs or $41B of the approximate $834B. One rough estimate is that approximately 10% of cancer care costs are spent on radiation oncology or approximately $5B
- In the 2000's, Medicare costs for Radiation Oncology represent approximately 8% of the Medicare expenditures or approximately $9B.
- 2002: ACS estimates $60.9B spent on cancer care, which means, after applying the 10% rule, approximately $6B on radiation oncology.

Radiation Oncology Costs

- As a rough estimate, it appears that radiation oncology costs in the early 2000's are between $5B to $10B per year.
- Less than half of this amount is paid to UT MDACC.

Radiation Oncology Costs

- Costs vs. Charges - An important distinction
- What must an institution charge per hour or per treatment to collect its costs for providing external beam radiation treatments?
- What is the charge per hour to collect costs for providing external beam planning?

Cost Accounting in Radiation Oncology: A Computer-Based Model for Reimbursement

Carlos A. Perez, M.D. et al.
Int J. Radiation Oncology Biol. Phys.
Vol. 25, 895-906, 1993

Cost Accounting: Perez

- 1991 Project - a procedure level cost accounting system of all of the costs involved in providing radiation oncology services
- Cost type: direct variable (labor and supplies), direct fixed (equipment), indirect variable (medical records), indirect fixed (building - exam rooms and offices, administration, computers, etc.)

Cost Accounting: Perez Average MD time per patient 1991

Activity	Minutes
• Consultation Complex	67
• Consultation Interm	54
• Sim. Complex	50
• Rx Planning Complex	45
• Review dosimetry	8

Cost Accounting: Perez Average time per patient 1991

Activity	CMD	PhD
CT	65 min	
Complex Ex Beam	47 min	
Interm. Ex. Beam	21 min	
Cont. Med. Physics	4.4 min	3.4 min

Cost Accounting: Perez Cost per procedure 1991

Activity	MD Professional	Planning Technical
Sim. Interm.	$188	$640
Rx Planning/ Isodose Complex	$147	$618

Cost Accounting: Perez Technical cost per Rx procedure 1991

Rx Interm.	$182
Rx Complex	$220
Gyn Implant	$1557

A Comparison of Two Methods for Estimating the Technical Costs of External Beam Radiation Therapy

James A. Hayman, M.D. M.B.A. et al.
University of Michigan

Estimating the Technical Costs of External Beam Radiation Therapy

- 1997 Data
- Cost Effective Analysis (CEA) estimates the additional cost per unit benefit associated with the use of a given intervention as compared to the most reasonable alternative strategy
- Int. J. Radiation Oncology Biol. Phys. 47, 461-467, 2000

Estimating the Technical Costs of External Beam Radiation Therapy

- Cost-to-Charge Ratios (CCR)
- Institution's annual operating costs
- CCR for therapeutic radiology 0.4542
- Cost Accounting Systems (CAS)
- CAS uses a bottom up approach to estimate the cost of labor, capital equipment, and overhead necessary to provide a particular service.

Estimating the Technical Costs of External Beam Radiation Therapy

- Four typical treatment approaches:
  - Simple palliative - 6 MV single field, simulation
  - Complex palliative - 10 MV POP, simulation, blocking
  - Breast -tangents + electron boost, simulation
  - Prostate - 35 Fx's 10 MV 4-field + CT simulation

Estimating the Technical Costs of External Beam Radiation Therapy

Activity	CCR Cost Est.	CAS Cost Est.
Palliative – S	$1285	$1195
Palliative – C	$2345	$1769
Curative Breast	$6757	$4850
Curative Prostate	$9453	$7498

Estimating the Technical Costs of External Beam Radiation Therapy

- The underlying cause of the difference between the two methods was primarily due to the estimated cost of delivering a daily treatment.

Comparison of Two Institutions

MIR
- 1991
- Rx Complex $221/fx

U of Michigan
- 1997
- Rx Complex
- CCR CAS
- $256/fx* $200/fx*
- *Estimated cost of CT study $500

Comparing the costs of radiation therapy and radical prostatecomy for the initial treatment of early-stage prostate cancer

Burkhardt et al. (ACR)
J Clin Oncol 2002 20(12):2869-75

Comparing the costs of radiation therapy and radical prostatecomy

- 1992 and 1993 Medicare approved payment amounts
- Direct medical costs
- Patients 65 and older and coded by the Surveillance, Epidemiology, and End Results (SEER) Registry

Comparing the costs of radiation therapy and radical prostatecomy

Average direct medical costs
- External beam RT
- $14,048 (95% CI, $13,765 to $$14,330)
- Assuming 35 Fx's, then the average direct medical cost per fraction is $400.

Average direct medical costs
- Radical prostatectomy
- $17,226 (95% CI, $16,891 to $17,560)

Modeling Direct Costs for RT Rx

Item	Initial Costs	Cost per Year
Rx Room (600 sq.ft at $250/ft^2)	$150,000	$25,000
Accelerator	$2,000,000	$300,000
Maintenance		$200,000
2 RTT's		$150,000
0.5 Physicist		$62,500
Approximate direct cost per hour		$350

Modeling Direct Costs for RT Rx

Direct costs per hour	$350
• Overhead	50%
• Total	$525
• Collection rate	50%
• Charge per hour for a Rx room	$1,050
• Charge per Rx (4 patients/hour)	$262

Modeling Direct Costs for RT Planning

Item	Initial Cost	Cost per year
Room, 225 ft^2 at $200 ft^2	$45,000	$6,500
Planning System	$300,000	$100,000
Software support		$50,000
Dosimetrist		$100,000
0.5 Physicist		$62,500
Approximate direct cost/hour		$150

Modeling Direct Costs for RT Planning

Direct costs per hour	$150
• Overhead	50%
• Total	$225
• Collection rate	50%
• Charge per hour for a Rx room	$450
• Charge per Plan (5 hours/plan)	$2,250

Average Treatment Times MIR*

- Conventional 10 min
- 3D CRT 18 min
- IMRT - MiMiC 30 min
- IMRT - SMLC 19 min

* J. Michalski M.D. Target Delineation Symposium, January, 2003

Average Treatment Times UT MDACC

Prostate	Head and Neck
• Conventional 10 min	• Conventional 15 min
• 3D-CRT 15 min	• 3D-CRT 20 min
• IMRT - SMLC 20 min	• IMRT - SMLC 25 min

Average Treatment Times UT MDACC

- At the risk of stating the obvious with a simple model, if the treatment time is doubled between conventional treatments and IMRT treatments, as is the case at UT MDACC, the cost of delivering such treatments will double
- Treatment room time is expensive.

Average Planning Times* UT MDACC Prostate

- Conventional 3.0 hours
- 3D-CRT 6.0 hours
- IMRT-DMLC 8.0 hours

* Treatment planning times are very difficult to estimate.

Time = Time(definition of task, learning curve, specific patient, etc.)

Planning time has decreased as a result of the use of a template and the electronic chart.

Average Planning Times* UT MDACC Head and Neck

- 3D CRT Initial effort 2.0 days
  Rework effort 1.5 days
- IMRT Initial effort 3.0 days
  Rework effort 2.0 days

One accepted plan per week from a CMD for H&N.

* Times are difficult to estimate, but UT MDACC is averaging between two to three plans per week per dosimetist.

Survey of Physics Time per Patient Procedure

- 2001 survey data from 30 institutions (11 academic and 19 community or free standing)
- Average qualified medical physicist hours per patient for IMRT - **12 hours**. This is divided between planning and QA
- Reimbursement versus Effort in Medical Physics Practice in Radiation Oncology, Herman, Mills, and Gillin, JACMP, March 2003

Survey of Physics Time per Patient Procedure Abt 2003 Survey

Procedure	Median QMP Total Time hours
77315 Complex	0.83
77301 IMRT	5.53
77370 Consultation	5.60
773xx IMRT Consultation	6.00

Physics Time per IMRT Patient

- Two independent surveys indicate that on the average physicists are spending 12 hours per patient.
- The cost of physics time depends upon the assumption of the number of hours worked per week.
- Assuming $50/hr for physics time, then the cost of physics effort per IMRT patient is approximately $600.

Staffing Patterns Abt 2003

	Overall	Com Hosp	Academic	Phys Con
Patients	1080	816	1500	465
MD's	4.0	2.8	7.5	1.5
Physicists	3.5	2.0	5.4	1.3
CMD/Jr P	2.5	1.9	4.0	1.3
Phy Asst	0	0	1	0
RTT's	7.0	6.0	10.5	3.8

Staffing Patterns Abt 2003

	Overall	Com Hos	Academic	Phy Con
Patients	1080	816	1500	465
Patients/ Physicist	309	408	278	358

IMRT Start Up Costs

- MCW
- Physics commissioning time 1 yr
- Planning system $170K
- QA Equipment $20K
- Delivery System $0 - Existing equipment used

- UT MDACC
- Physics commissioning time 1 - 2 yrs.
- Planning systems >$500
- QA Equipment $20K
- Delivery Systems >$300K - Mimic purchased

Estimated Added Cost for IMRT at UT MDACC

- Corvus Planning System(s) $40K/yr/system
  9 clinical systems
- MiMiC (Used for < 3 years) $90K/yr
- QA Equipment $20K/yr
- MLC's ? Also used for 3D CRT
- QA Specialists 2 FTE/yr $125K/yr
  Perform routine QA which is required for every patient.

Estimated Added Cost for IMRT at UT MDACC/Year

- Planning Computers: $360K
  9 ea x $40K
- Labor $640K
  (2 QA specialists, 1 additional engineer, 2 additional dosimetrists, 2 additional physicists)

Total $1M+

Rough estimate of the additional costs above existing costs for IMRT.

UT MDACC IMRT
Are the added costs recovered?

- This is very difficult to know for sure
- Substantial charges are generated
- If the added expenses are $1M/year, and if the service is offered on 5 Rx units, then an additional $100/hr/machine must be collected, so $200/hr must be billed
- Charge per hour per machine has increased by > 20%for IMRT services.

2003 Medicare Payments for HOPPs

APC	Description	Payment Rate
0300	Level I, RT	$82.37
0301	Level II, RT	$164.73
	IMRT	$400
0305	Level II, RT Prep	$190.51
0310	Level III, RT Prep	$712.51
	IMRT Dose Plan	$875

UT MDACC Costs versus 2003 Medicare Payment Schedule

- Medicare IMRT Planning $875
- H&N Planning Labor Costs
  5 days of CMD time $2,000
- H&N Planning Computer Costs/week
  $1,000
- $3,000 vs $875
- More efficiency is needed, e.g.

Economic Considerations

- Is the added cost in terms of time in the treatment room, time in the planning, time in QA,and additional equipment required by IMRT reimbursed by Medicare 2003 rates?
- Possibly, depending on time spent delivering treatment and time spent in planning

Socio-Economic Considerations UT MDACC Planning Activity

Appropriate use of technology

January, 2003 Plans			February, 2003 Plans		
• Complex	200	47%	• Complex	170	45%
• 3D	175	40%	• 3D	170	45%
• IMRT	55	13%	• IMRT	40	10%

Socio-Economic Considerations UT MDACC Planning Activity

Appropriate use of technology

March, 2003 Plans			April, 2003 Plans		
• Complex	175	47%	• Complex	170	42%
• 3D	155	42%	• 3D	175	44%
• IMRT	40	11%	• IMRT	55	14%

Socio-Economic Considerations UT MDACC Planning Activity

Appropriate use of technology, April, 2003

- IMRT Plans per Service
- CNS 4%
- GU 46%
- GYN 13%
- H&N 29%
- THORACIC 8%

Socio-Economic Considerations

- The appropriate allocation of cancer care, which is based upon cost-effectiveness or efficacy, is a very challenging exercise. In a 1992 JAMA article Eddy identified the 4 toughest problems:
  1. Defining an understandable benefit, e.g. lives saved
  2. Dealing with inadequate information
  3. Measuring the costs of care
  4. Defining the treatment efficacy outside of a clinical trial, i.e. clinical trial results may not transfer directly to the community setting

Socio-Economic Considerations

- For the purposes of discussion, assume that IMRT long term outcomes are equal to 3D-CRT outcomes, but have a 50% lower complication rate for prostate cancer patients with Gleason 7 and PSA < 15
- Also assume that the technical treatment costs for IMRT are double than of 3D-CRT, $10K to $20K
- From a socio-economic perspective, can the added cost to lower the complications be justified?

Socio-Economic Considerations

- Possibly yes, if the patient is a healthy 60 year old male who is expecting to work for another 10 years and whose life expectancy is approximately 20 years
- Possibly no, if the patient is a 75 year old whose life expectancy is less than 5 years

Socio-Economic Considerations

- Consider a H&N patient, who is receiving IMRT.
- Assume the cost of IMRT over 3D CRT is 1.3 times greater.
- If the principle benefit to the patient is continued saliva product and if there is a 1 in 2 chance of this benefit, can the added cost (>$4K) be justified?
- If Yes, should the patient, as opposed to insurance, be expected to pay for this additional cost?

Economic Burden of Cancer Cost of Illness

- Direct cost: medical procedure and services
- Morbidity cost: lost income due to disability
- Mortality cost: lost income due to premature death
- From this socio-economic perspective, time in terms of years lived represents money and it is easier to justify high costs if there is a longer life expectancy with a higher quality of life.

Economic Burden of Cancer ACS Data

- 2002 NIH estimates overall annual cost of cancer:
  - Direct $60.9B
  - Morbidity Costs $15.5B
  - Mortality Costs $95.2B

It is interesting to note that the largest component in the cost of cancer is the cost of productivity due to premature death.

Economic Burden of Cancer

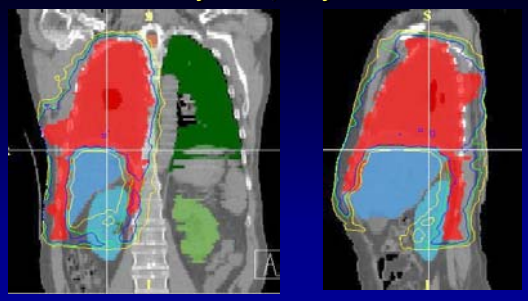
- In 1997 four cancer sites, lung, prostate, breast, and colon/rectum accounted for 52% of the estimated new cancers and 55% of the estimated cancer deaths. The relative 5 year survival rates are 93% for prostate, 86% for breast, 61% for colorectal and 14% for lung.
- Will IMRT make a significant survival contribution to any of these sites besides prostate with its 93% 5 year survival?

Socio-Economic Considerations

- The potential economic gains from any new, effective cancer therapy are substantial
- For example, a 2% increase in the cure rate, 10,000 lives, could save $1B (1/75 of the total cost of cancer care in 2000), assuming that the cost of care for these patients as their disease progresses through end of life is $100,000

IMRT and Mesothelioma

30 Gy Yellow, 50 Gy Blue



Socio-Economic Considerations

- One fundamental economic fact that perseveres in cancer management is that an expensive cure is far less costly in the long run than a treatment failure.

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Socio-Economic Considerations

- Houston Chronicle June 8, 2003
  Milton Weinstein - Kaiser Professor of Health Policy and Management at Harvard School of Public Health
- "We now ration health care, so why not do it rationally?"
- Quality-adjusted life years - QALYs

Socio-Economic Considerations

- "… we could save more quality-adjusted years of life - five times as many in this example - if mammograms were done every two years and the money saved was spent on giving every woman a colonoscopy every 5 to 10 years. But at the present time, more women get annual mammograms than ever get screened for colon cancer."

Socio-Economic Considerations

- The New York Times NATIONAL Sunday, June 8, 2003. White House Memo - Richard Stevenson
- "After signing his third tax cut into law last month and plunging into Middle East peacekeeping this past week, Mr. Bush is now making Medicare his focus. …"

Socio-Economic Considerations

- When will Medicare apply a QALY's analysis on the treatment of patients with lung cancer?
- Stage III Lung Cancer -
  - workup includes multiple CT exams and now PET.
  - Treatment may soon include an IMRT, gated, guided with multiple image sets treatment with protons.
  - Survival < 10%