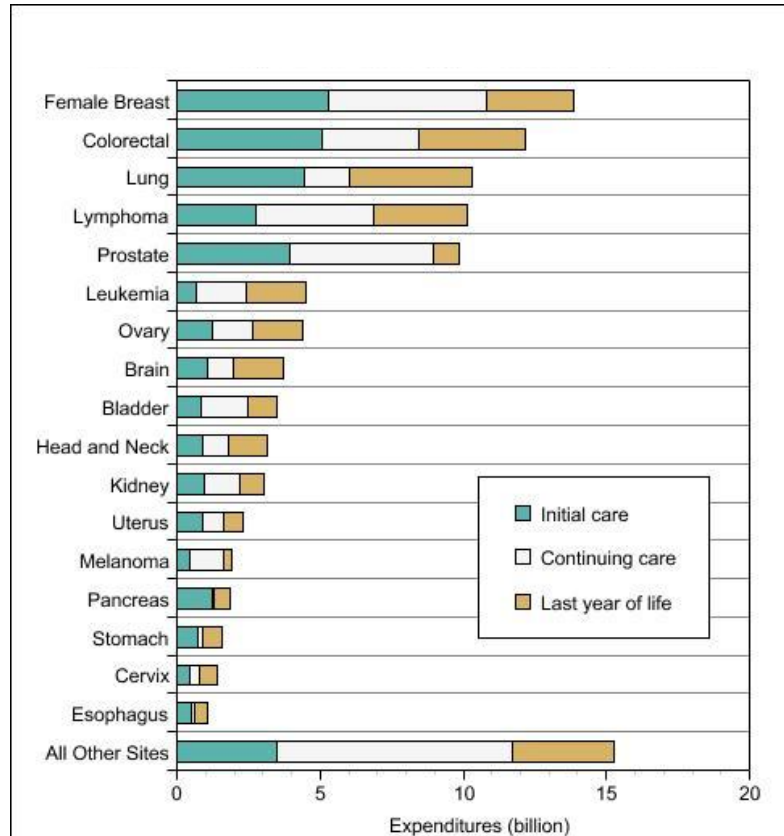


# Cost Effectiveness of IO RT

Michael Alvarado, M.D.

University of California San Francisco

# Estimates for Cancer Care by Site and Phase of Care



Source: Based on methods for estimating and projecting cancer prevalence by phase of care described in Mariotto AB, Yabroff KR, Feuer EJ, De Angelis R, Brown M. Projecting the number of patients with colorectal carcinoma in initial, monitoring and last year of life phase of care in the US: 2000 – 2020. *Cancer Cause Control*, 2006; 17:1215–1226. Methods for estimating costs by phase of care are described in Yabroff KR, Lamont EB, Mariotto A, Warren JL, Meekins A, Topor M, Brown ML. Cost of care for elderly cancer patients in the United States. *J Natl Cancer Inst* 2008;100:630–641. Cost estimates expressed in 2006 dollars using CMS cost adjusters and adjusted for out-of-pocket expenditures, including co-payments and deductibles. Estimates for the population younger than 65 were developed using ratios of cost in the younger than 65 and older 65 populations from studies conducted in managed care populations.



[News Office Homepage](#)

# Cost-effectiveness research needs to be considered in developing new medical technology

February 18, 2011

Cost-effectiveness analysis should play a bigger role in the American health care system, argued a University of Chicago researcher Friday at the annual conference of the [American Association for the Advancement of Science](http://www.aaas.org/) (<http://www.aaas.org/>) .

"Because technology is the major driver of increases in health care and a critical driver of improvements in health, rigorous methods to assess the costs and effectiveness of health care technology are critical for effective resource allocation," Meltzer said. By using cost-effectiveness methods in studying health care, researchers and policymakers can better understand the value of innovation, he said.

# Measuring Cost-effectiveness

- Summary measure of health benefit or outcome-QALY
- Includes both quality and quantity of life
- Adjusted for the desirability of, or preference for the benefit achieved
- Only health status measures, with preferences / utilities assessed, can be used in economic analysis
- Only a few health status measures (generic or specific) have preferences / utilities measured

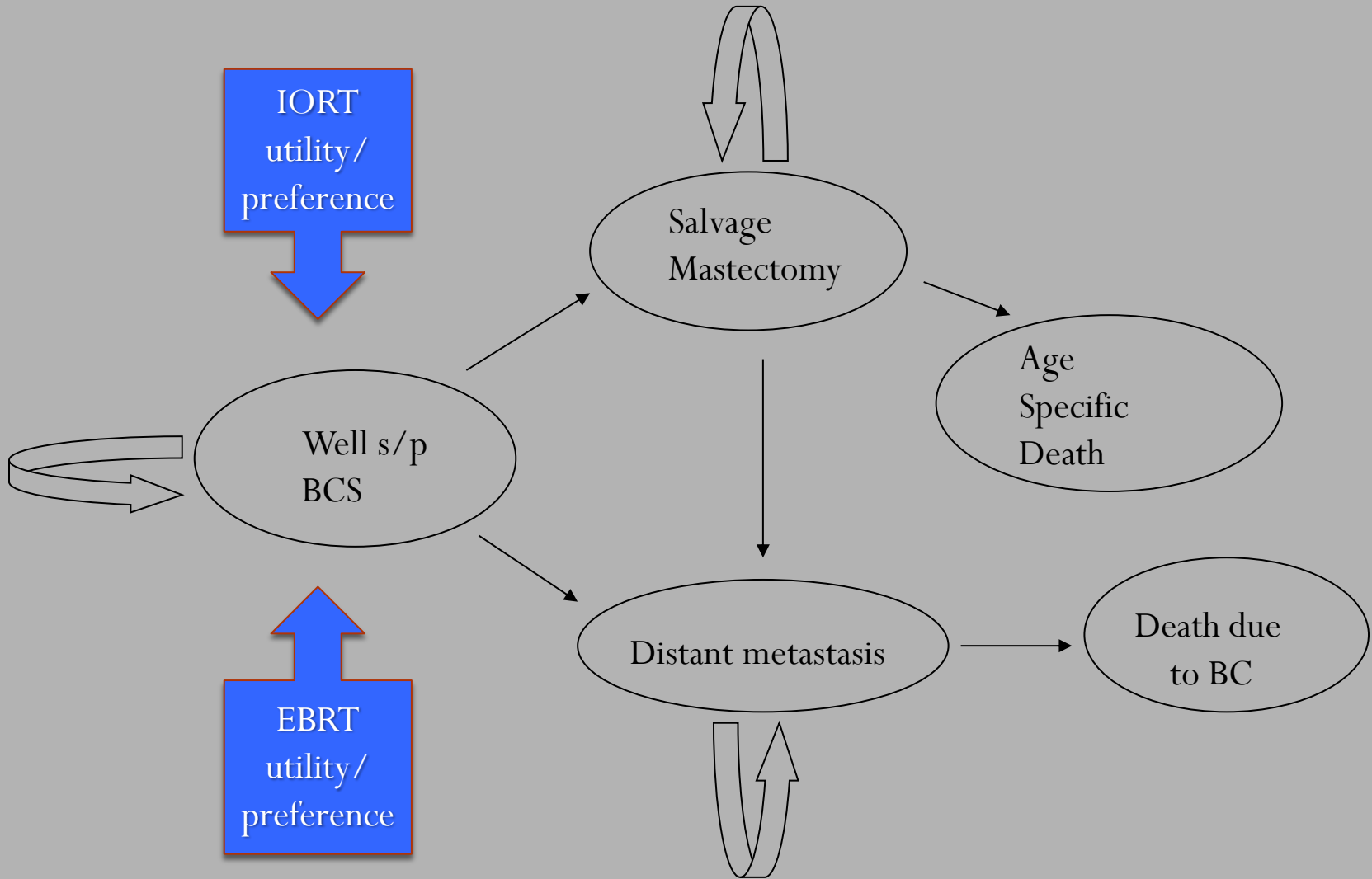
# Building the Markov Model

- TreeAge® software (Williamstown, MA)
- Primary outcomes:
  - Incremental cost effectiveness ratio (ICER), quality of life years (QALY) gained and life expectancy
    - ICER threshold for acceptance is  $\leq$  \$75,000 per QALY
- Assumptions
  - Local, metastatic recurrence rates, and utilities
    - Focused on biology of T1-2 N0 Grade 1,2 tumors
  - Base case: 10 years: EBRT LR 2x, IORT LR 2x+ 2.5
- Sensitivity Analysis
  - Vary recurrence rates, vary utilities

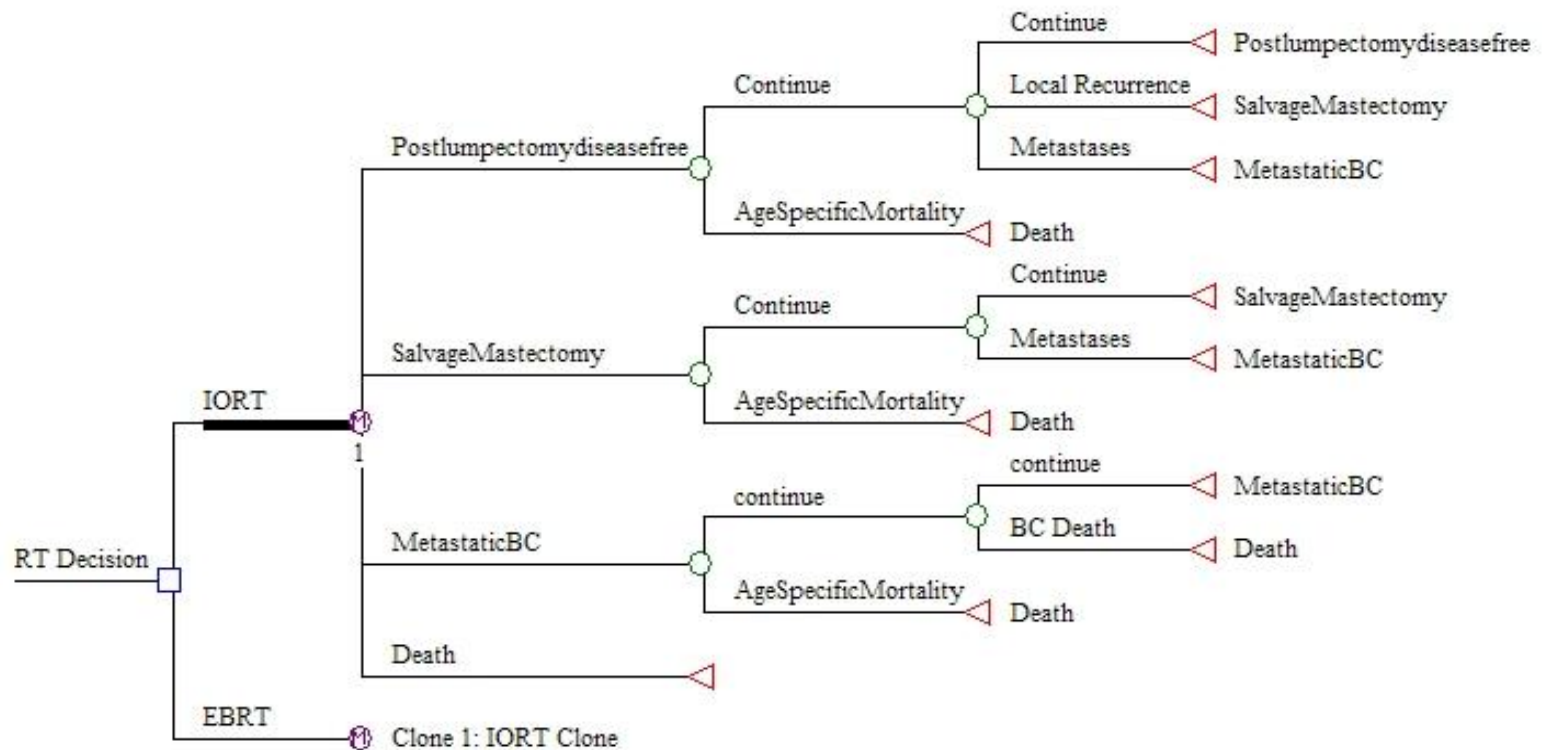
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- Sensitivity Analysis
  - Vary recurrence rates, vary utilities

# Health State Flow Diagram



# Strategies Evaluated





# Selected Model Inputs Base Case

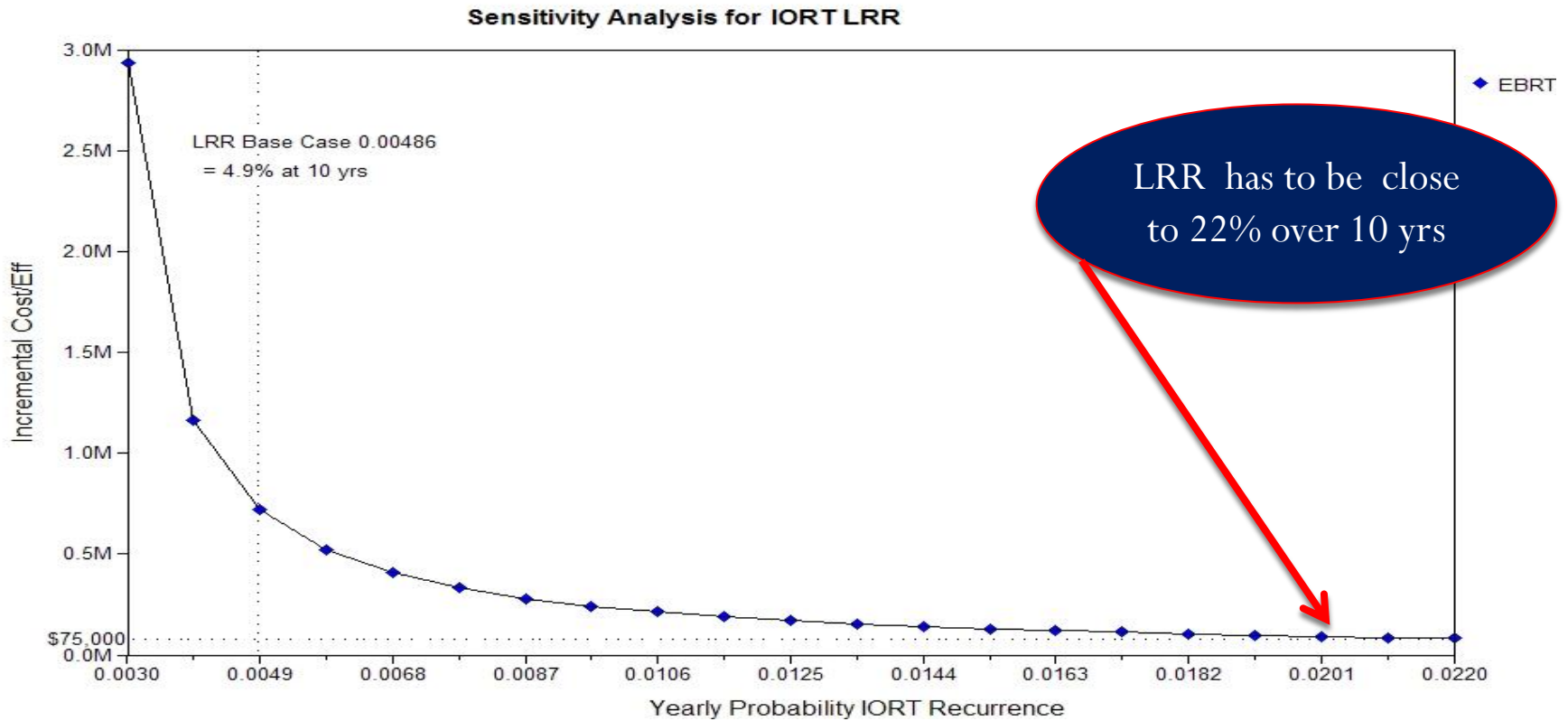
Selected Model Inputs for Base Case					
<b>Rates (10 Year)</b>		<b>Costs</b>		<b>Utilities*</b>	
LRR IORT	4.9%	IORT	\$3,129	IORT	0.92
LRR EBRT	2.4%	EBRT (6wk)	\$8,154	EBRT	0.92
Metastatic BC	11%	EBRT (3wk)	\$5,219	Salvage Mastectomy	0.82
Metastatic BC post Salvage Tx	20%	Salvage Mastectomy +Reconstruction	\$5,105	Metastatic BC	.70
MBC mortality (per year)	34%	EBRT Indirect costs	\$1,727	Death	0

\*Hayman JA, Hillner BE, Harris JR, et al. Cost-effectiveness of routine radiation therapy following conservative surgery for early-stage breast cancer. J Clin Oncol 1998

# Results

- Under the assumption that IORT and EBRT *utilities / preference* are equivalent, IORT is less costly than EBRT, but also slightly less effective in terms of both life expectancy and QALYs when IORT LRR was set at the non-inferiority limit
- However, the ICER under these settings EBRT was more than \$500,000 per QALY saved, much higher than the typically accepted willingness-to-pay threshold of \$75,000

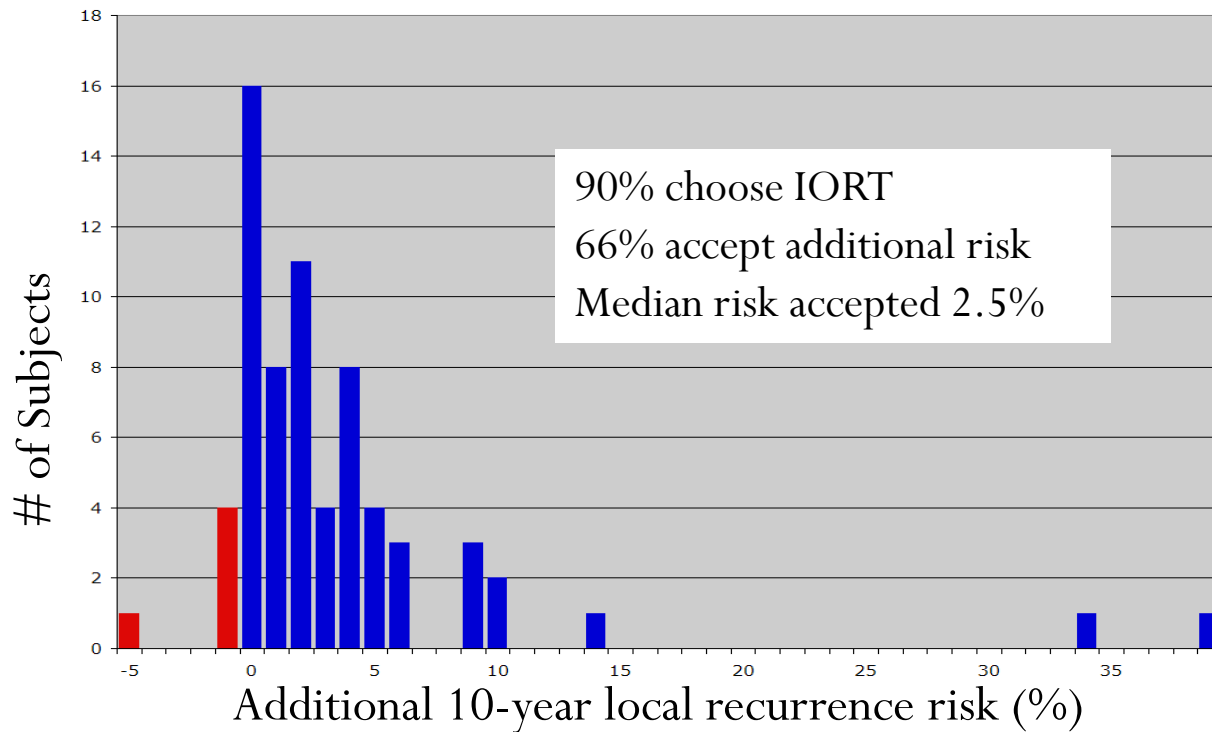
# Results



- EBRT is only cost-effective when the 10yr LRR for IORT is 22%

# Utilities and Preference

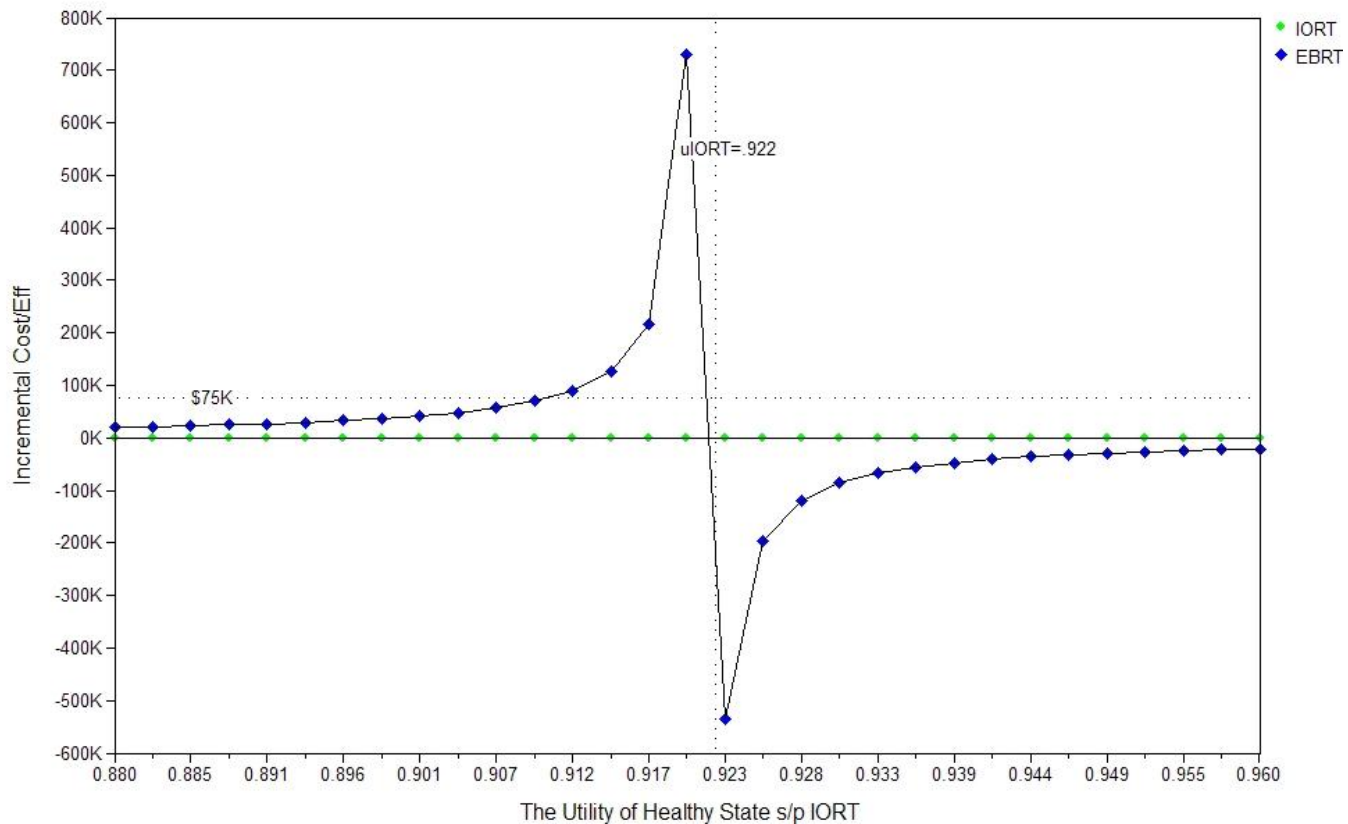
Additional Accepted Risk of Local Recurrence to Receive  
Intraoperative Radiation



# Utilities and Preference

- Have assumed both EBRT and IORT to have equal utilities
- Data strongly supports this is not the case
- How does model change as the *utility/preference* vary?

# Sensitivity Analysis for Utility (preference) of IORT



Incremental Cost-Effectiveness Ratio of EBRT decreases with increased IORT Utility

Utility	0.880	0.901	0.912	0.920	0.922	0.930
ICER (\$/QALY)	20,012	41,581	90,182	730,994	$\infty$	Dominated

If the utility (preference) for IORT is greater than 0.921, IORT becomes the dominant strategy, offering greater QALYs for less cost.

# Add updated model

- Add salvage lumpectomy
- Change LRR to TARGIT A data
- Re-run model

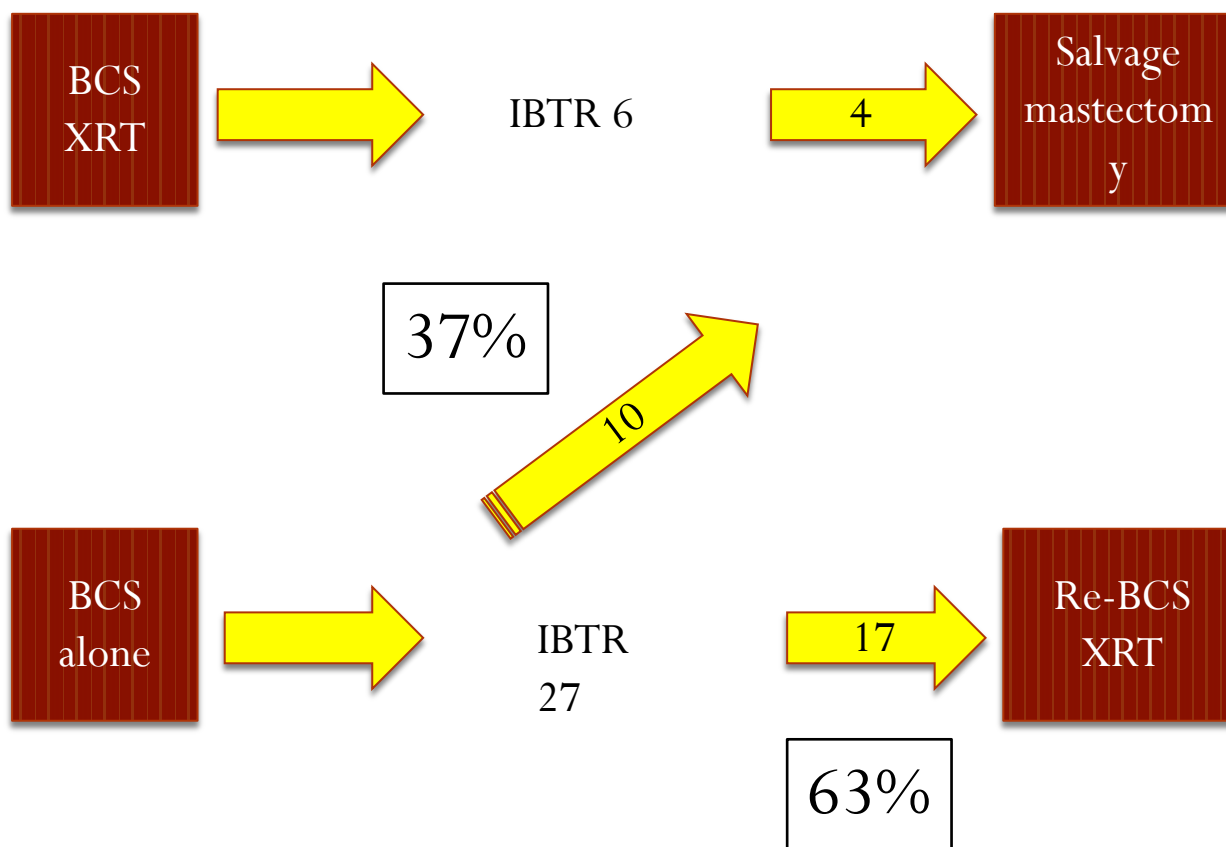


# Revised Model Inputs Base Case

Selected Model Inputs for Base Case					
Rates (10Year)		Costs		Utilities*	
LRR IORT	3.0%	IORT	\$3,129	IORT	0.92
LRR EBRT 6wk	2.4%	EBRT (6wk)	\$8,154	EBRT	0.92
LRR IORT and EBRT	3.0%	EBRT (3wk)	\$5,219	Salvage Mastectomy	0.82
LRR EBRT 3wk	6.2%	Salvage Mastectomy + Reconstruction	\$5,105	Salvage Lumpectomy	.87
LRR after salvage BCS + EBRT	38%	EBRT Indirect costs	\$1,727	Metastatic BC	.70

\*Hayman JA, Hillner BE, Harris JR, et al. Cost-effectiveness of routine radiation therapy following conservative surgery for early-stage breast cancer. J Clin Oncol 1998

# Model Changes: CALGB 9343

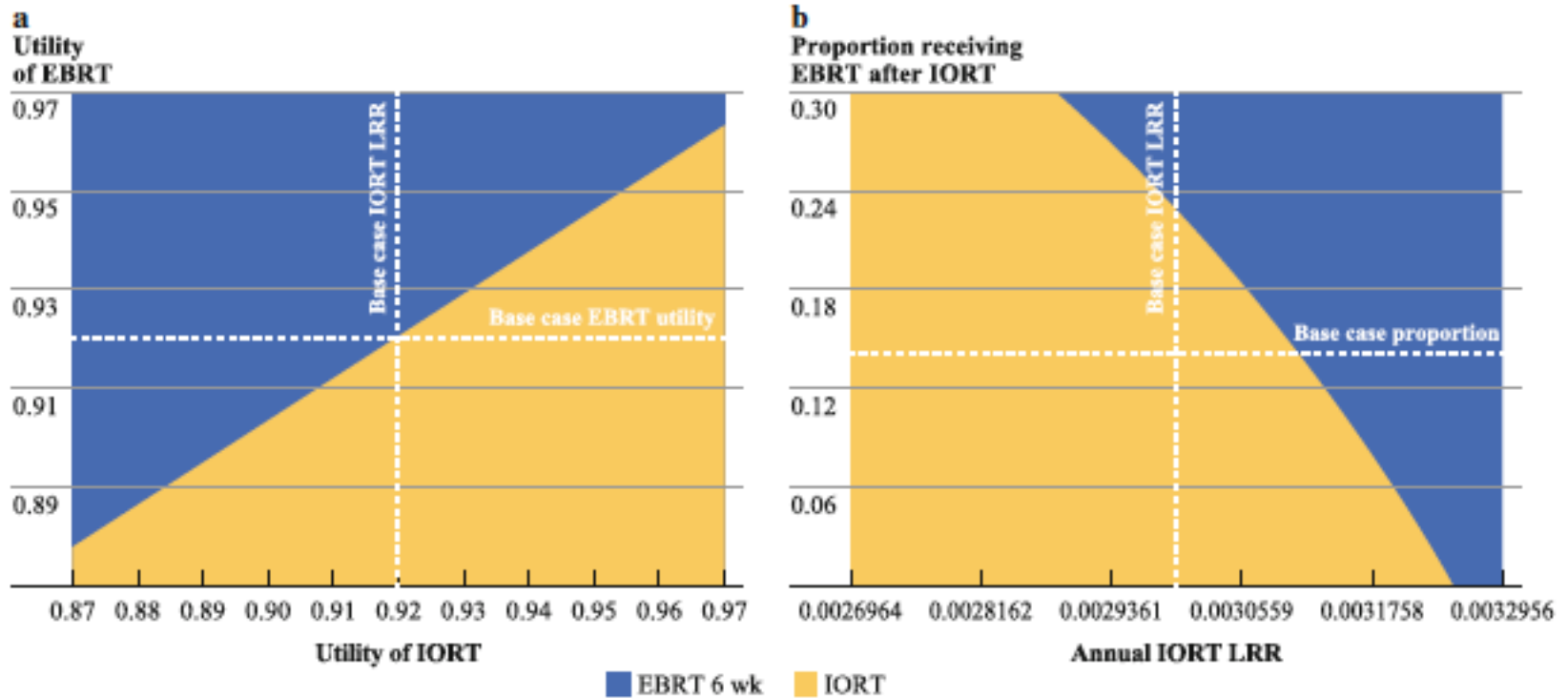


# Baseline Results

	IORT	3-week EBRT	6-week EBRT	Differential 3 week/IORT	Differential 6 week/IORT
Life Expectancy	8.38240	8.38152	8.38257	-0.00088	0.00017
QALYs	7.66020	7.64618	7.65994	-0.01402	-0.00026
COST	\$28,879	\$29,789	\$34,070	\$910	\$5,191
ICER	-	Dominated	Dominated	-	-

# results

- Two way sensitivity analysis



# Radiation in an Elderly Population

VOLUME 30 · NUMBER 14 · MAY 10 2012

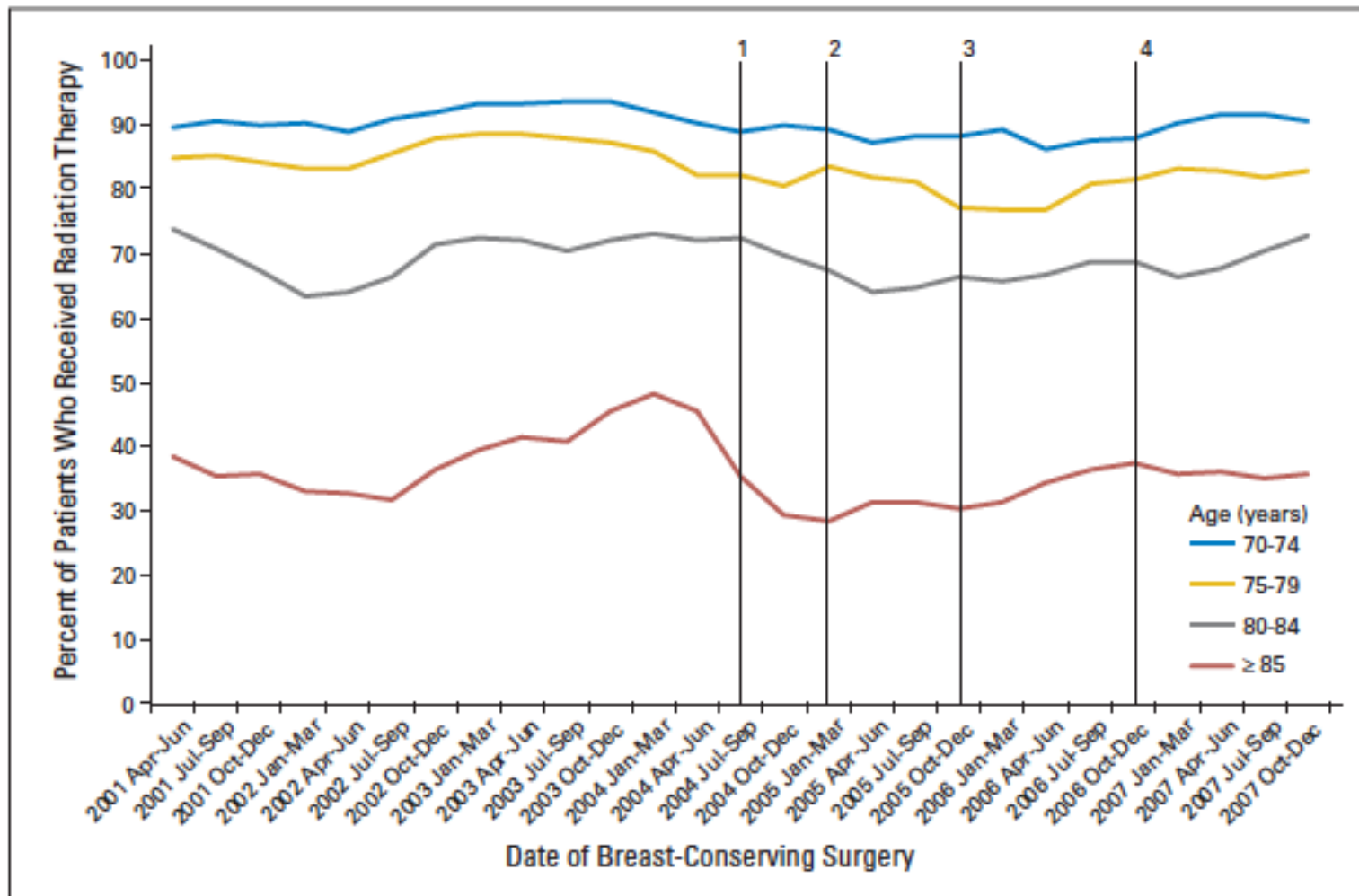
JOURNAL OF CLINICAL ONCOLOGY

ORIGINAL REPORT

## Assessing the Impact of a Cooperative Group Trial on Breast Cancer Care in the Medicare Population

*Pamela R. Soulos, James B. Yu, Kenneth B. Roberts, Ann C. Raldow, Jeph Herrin, Jessica B. Long, and Cary P. Gross*

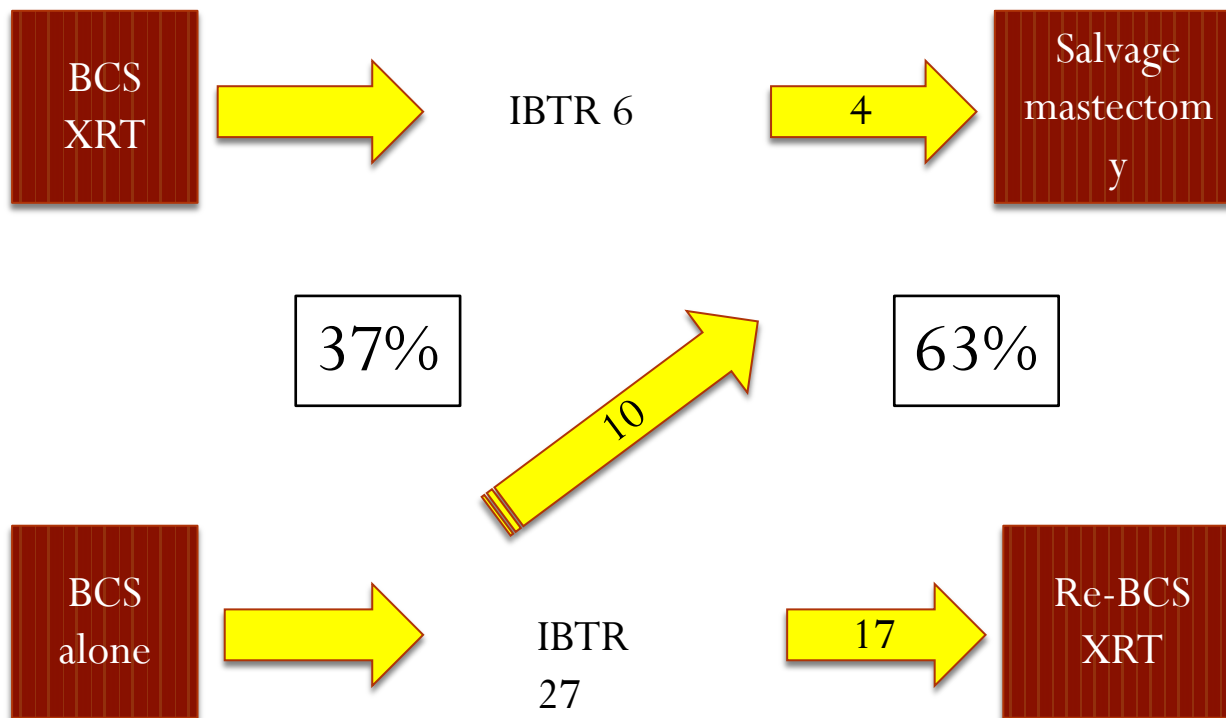
# Percent receiving XRT by age



# Cost-effectiveness of IORT for Elderly

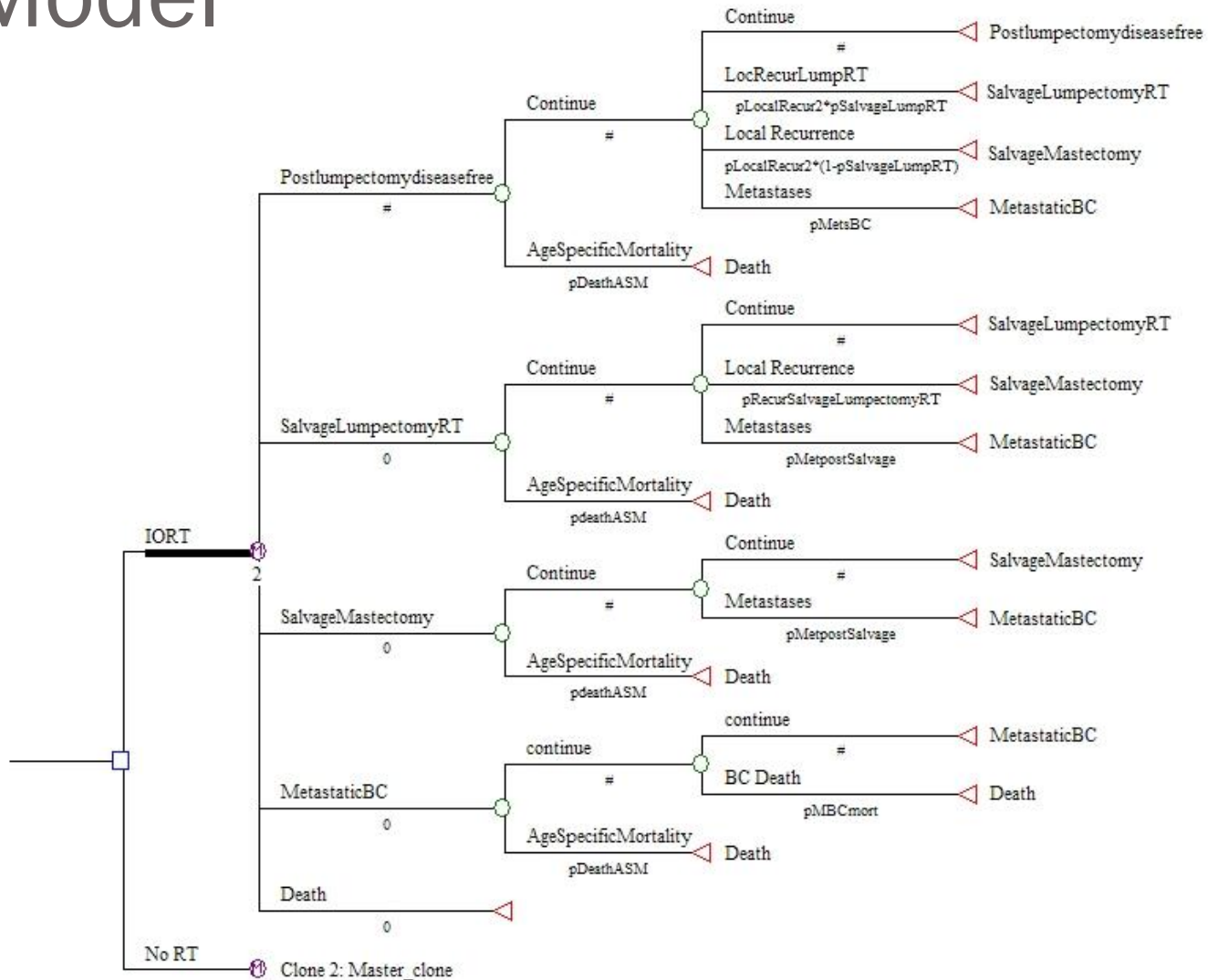
- Data from CALGB for elderly pts (Hughes et. al.)
- Lumpectomy XRT vs. Lumpectomy alone
  - XRT arm = 2% LR
  - Lumpectomy alone = 9% LR
- No difference in survival

# Model: IORT vs no Radiation





# Model

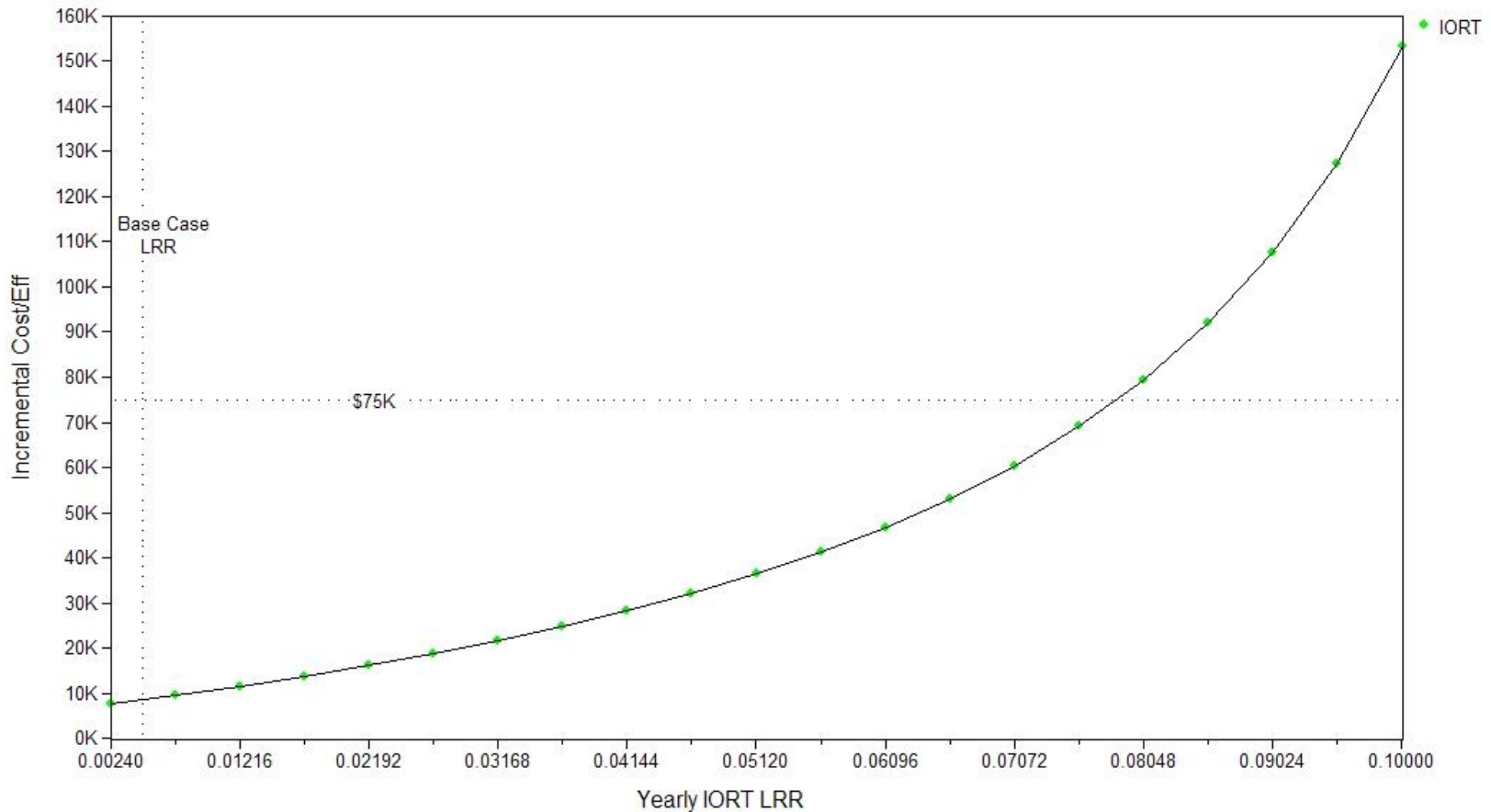


# Results

- In the baseline analysis, IORT is more costly than lumpectomy alone, but more effective in terms of QALYs.
- The use of IORT led to an increase in .32 QALYS but an incremental increase in \$2,900, resulting in an ICER of \$8,956 per QALY.

# Results

Sensitivity Analysis for IORT LRR



IORT is cost effective with an ICER of \$8000 per QALY, well below accepted value of \$75,000 even with conservative assumptions of LRR and utility

# Conclusions

- IORT is not only cost-effective but also cost-saving for early stage breast cancer when compared to standard external beam radiotherapy
- The addition of IORT in the elderly population is an acceptable alternative to BCS alone without the significant costs, inconvenience and adverse effects of whole breast radiation

# Early Adoption

Breast Cancer Res Treat (2014) 144:371–378

DOI 10.1007/s10549-014-2881-2

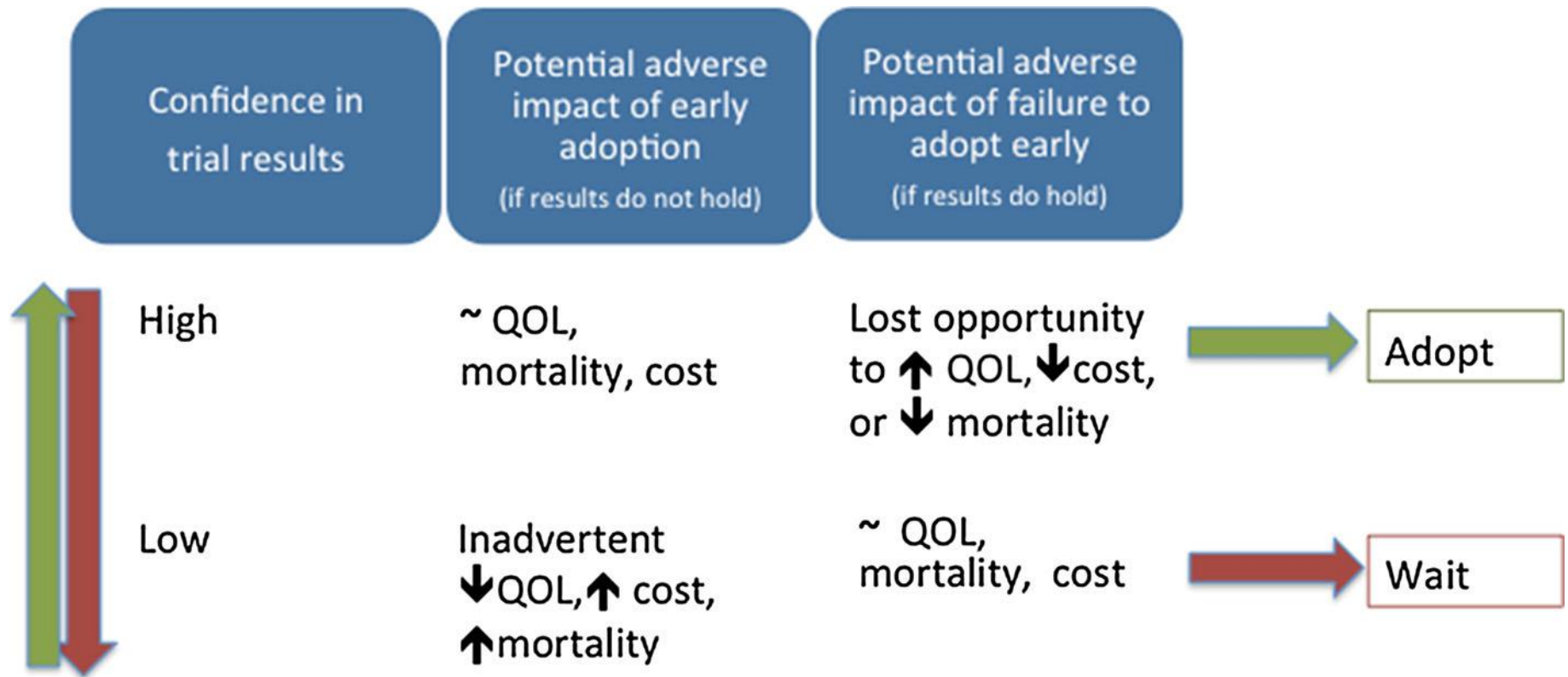
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CLINICAL TRIAL

## **Application of a decision analytic framework for adoption of clinical trial results: are the data regarding TARGIT-A IORT ready for prime time?**

**L. J. Esserman · M. D. Alvarado · R. J. Howe ·  
A. J. Mohan · B. Harrison · C. Park ·  
C. O'Donoghue · E. M. Ozanne**

# Adoption Framework



# Adoption Framework Analysis

- Confidence?
  - Comparison of results and peak hazards to similar trials suggest TARGIT A results stable.
- Adverse Impact Early Adoption?
  - No impact on life expectancy for wide range of recurrence rates for TARGIT policy
  - Even at LRR 10% for TARGIT arm only 0.002 fewer expected life-years
- Potential Adverse Impact of NOT Implementing?
  - ~70,000 women TARGIT eligible each year in US
  - Stage I,II, node negative, Grade I/II
  - Economic burden if not implemented for 5 years \$2.2 Billion

# Acknowledgements

Elissa Ozane, PhD.

Laura Esserman, M.D.

Aron Mohan, M.D.



Thank you