



***Population-Based Colorectal Cancer
Modeling***

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Acknowledgements

The CISNET logo is located in the top right corner of the slide. It features the word "CISNET" in a bold, black, sans-serif font. The letters are set against a background of colorful, abstract shapes in shades of pink, orange, yellow, and purple.

- Erasmus MC – Memorial Sloan-Kettering consortium
- Part of NCI's CISNET program



**CANCER INTERVENTION AND
SURVEILLANCE MODELING NETWORK**

Outline

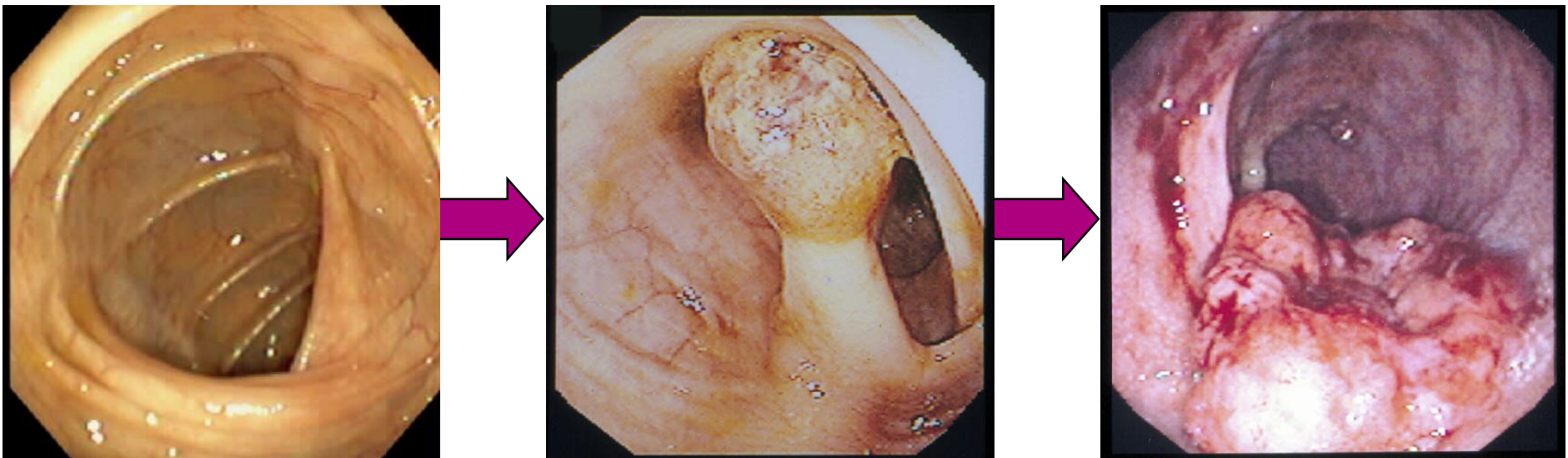


- Background on colorectal cancer and micro-simulation modeling
- CRC mortality projections as a function of cancer control interventions to 2020 in the United States
- Economic evaluation for Medicare coverage decision of novel screening modalities
- Impact of a public program promoting colorectal cancer screening in Ontario, Canada

Adenoma to Carcinoma Pathway

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- Colorectal cancer (CRC): 2nd cause of cancer death in Europe
- CRC develops through Adenoma-Carcinoma Pathway:



Normal
Epithelium

Small
Adenoma

Advanced
Adenoma

Colorectal
Cancer

Prevention of Colorectal Cancer



➤ Lifestyle

- ◆ Smoking, red meat and obesity increase CRC risk
- ◆ Physical activity, multivitamins, aspirin and hormone replacement therapy decrease CRC risk

➤ Screening

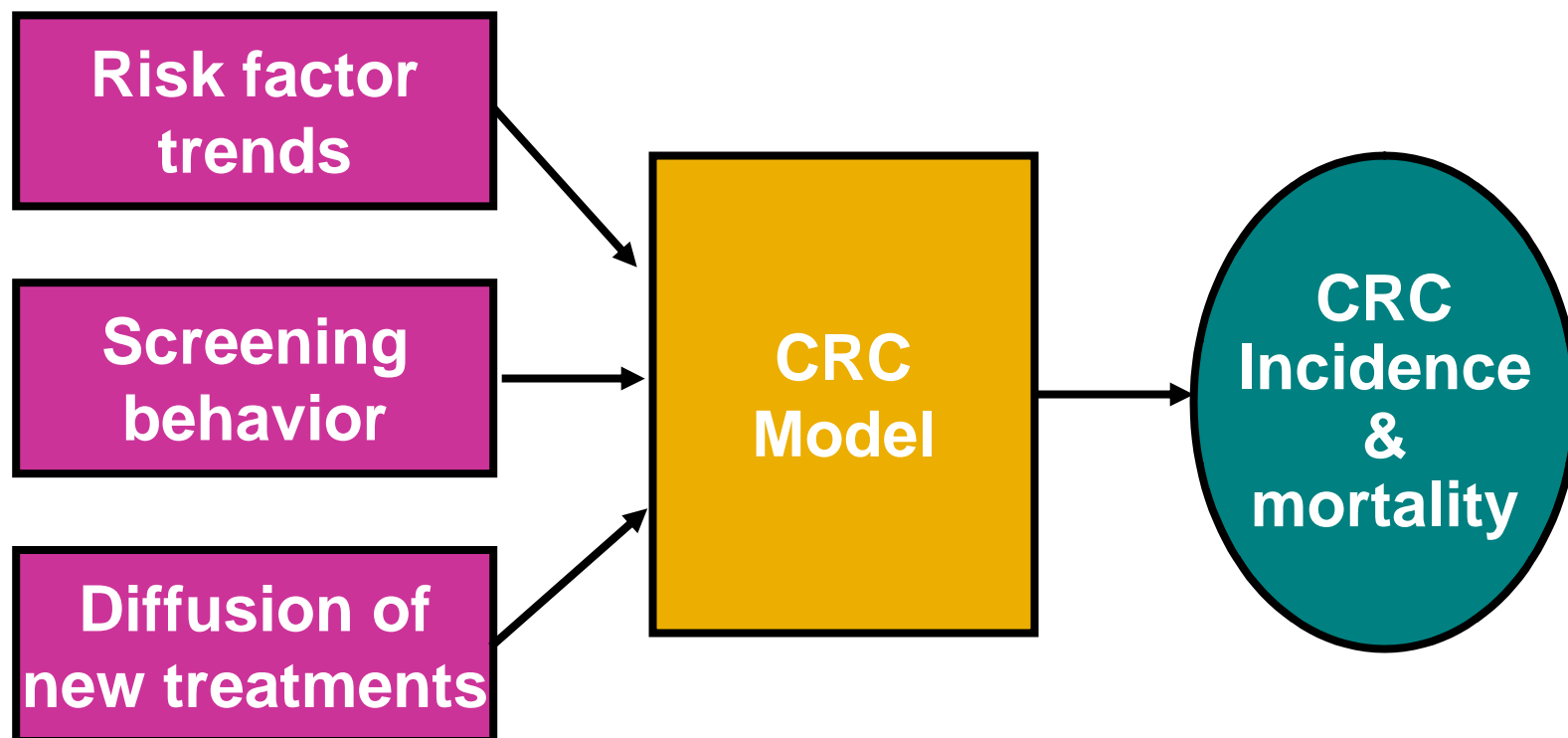
- ◆ Fecal Occult Blood Tests (FOBT), Sigmoidoscopy and Colonoscopy

➤ Treatment

- ◆ Surgery, Radiation and Chemotherapy

Population Simulation Model

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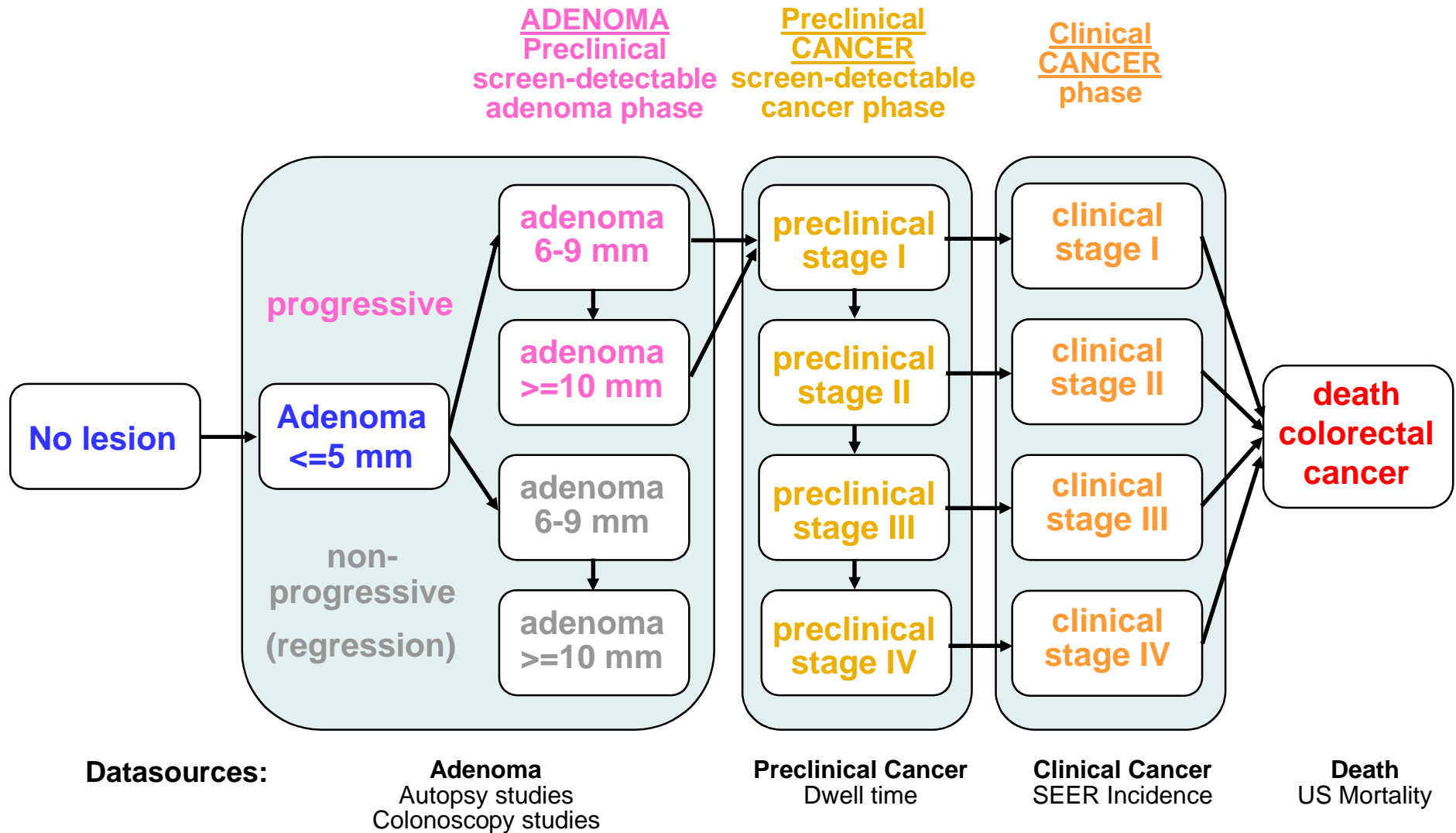


Upstream

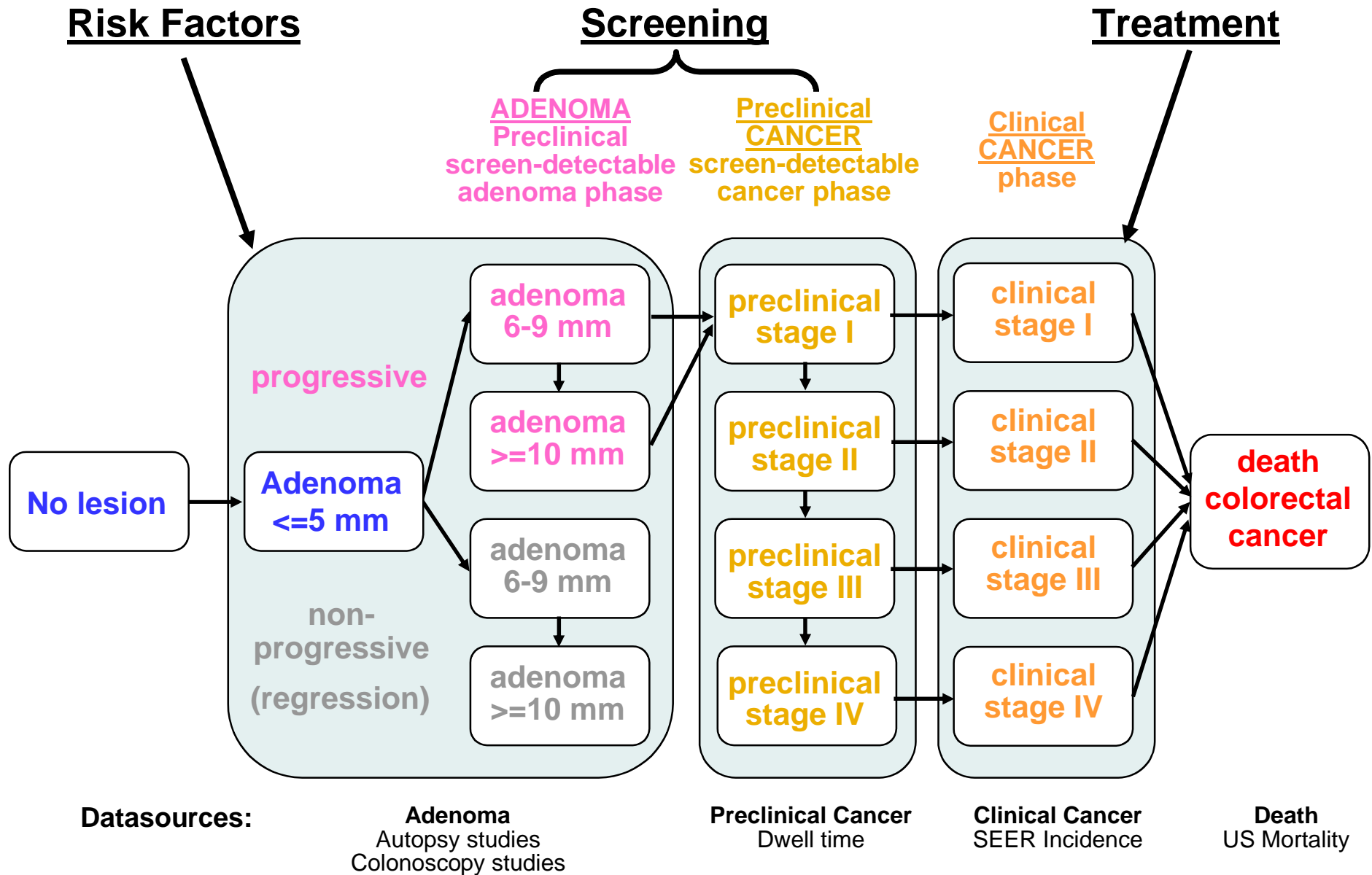
Downstream



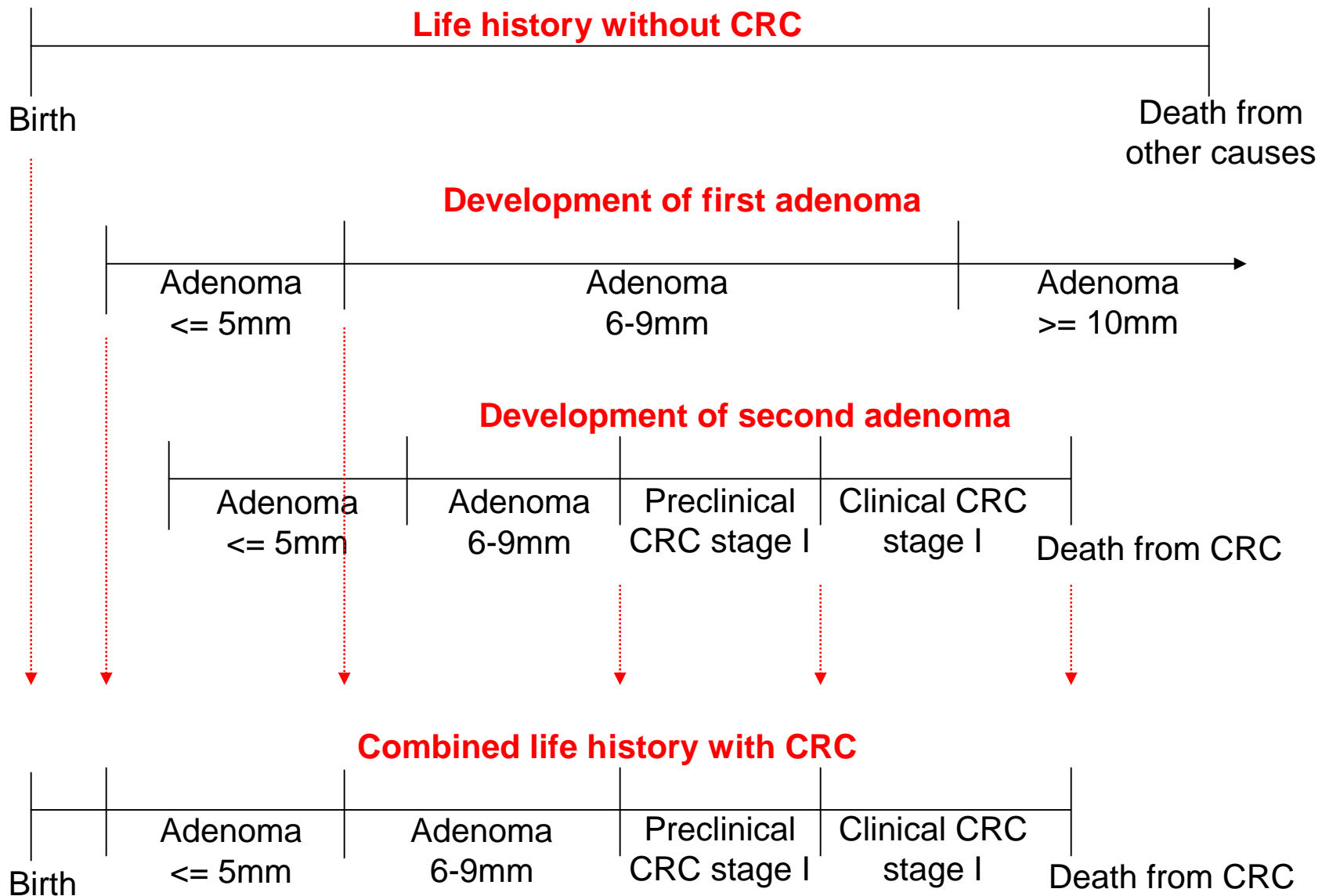
Natural History of Colorectal Cancer



Interventions on Colorectal Cancer



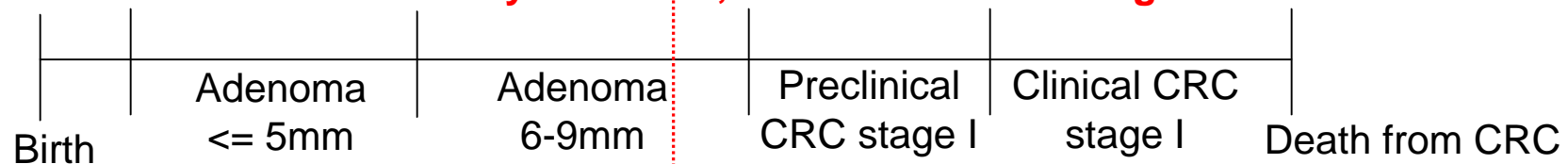
Methods – Simulating Life Histories



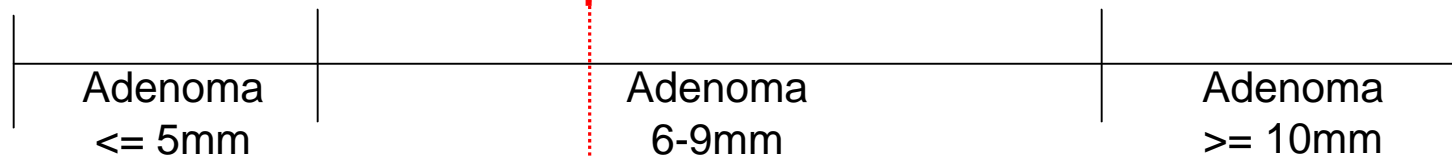
Methods – The effect of screening



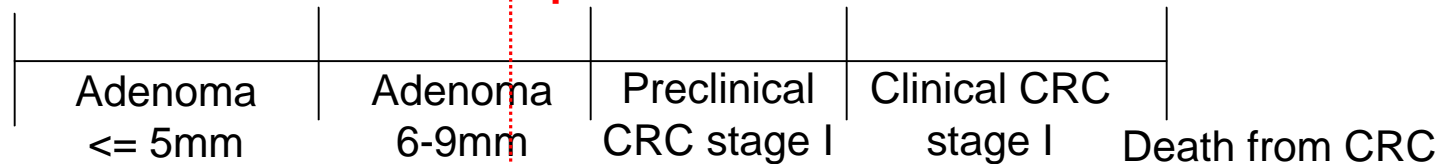
Life history with CRC, but without screening



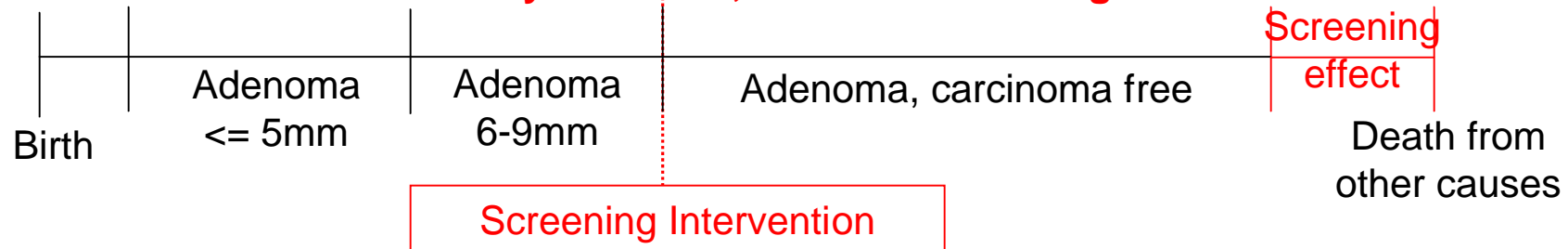
Development of first adenoma



Development of second adenoma



Life history with CRC, and with screening





Example 1.
Projecting Colorectal Cancer
Mortality to 2020

Healthy People 2010 Mortality Goals for Cancer



- Healthy People nationwide health promotion and disease prevention agenda in US

- HP2010 mortality goal for colorectal cancer
 - ◆ 34% decline in mortality
 - ◆ per 100,000: 21.2 in 1998 → 13.9 in 2010

Will the HP2010 goal for CRC mortality be reached with current interventions?

Projection Questions



- Given reasonable projections of screening, treatment and risk factor levels, what level will mortality reach in 2010 and beyond?

- What are the best cancer control opportunities?
 - ◆ Best *short term* opportunities
 - ◆ Best *long term* opportunities

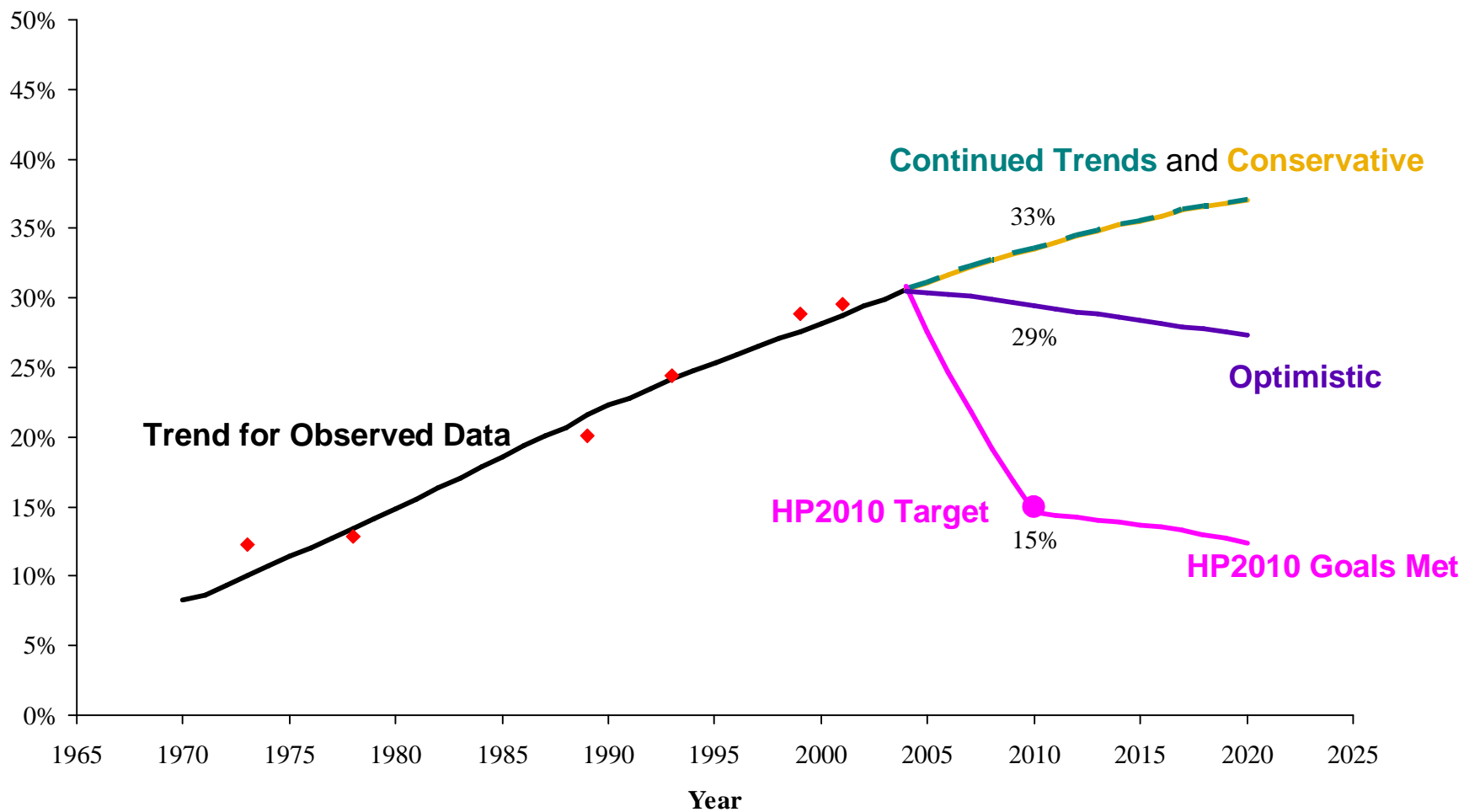
Scenarios Modeled for Upstream Factors – Colorectal Cancer



<i>SCENARIO</i>	<i>DESCRIPTION</i>
CONSERVATIVE	Upstream factors remain frozen at levels achieved in 2005
CONTINUED TRENDS	Continuation of past trends
HP2010 UPSTREAM GOALS MET	Use continued trends for factors with no explicit upstream goals
OPTIMISTIC	Difficult but feasible “best case” levels of upstream factors

Risk Factor Example: Obesity

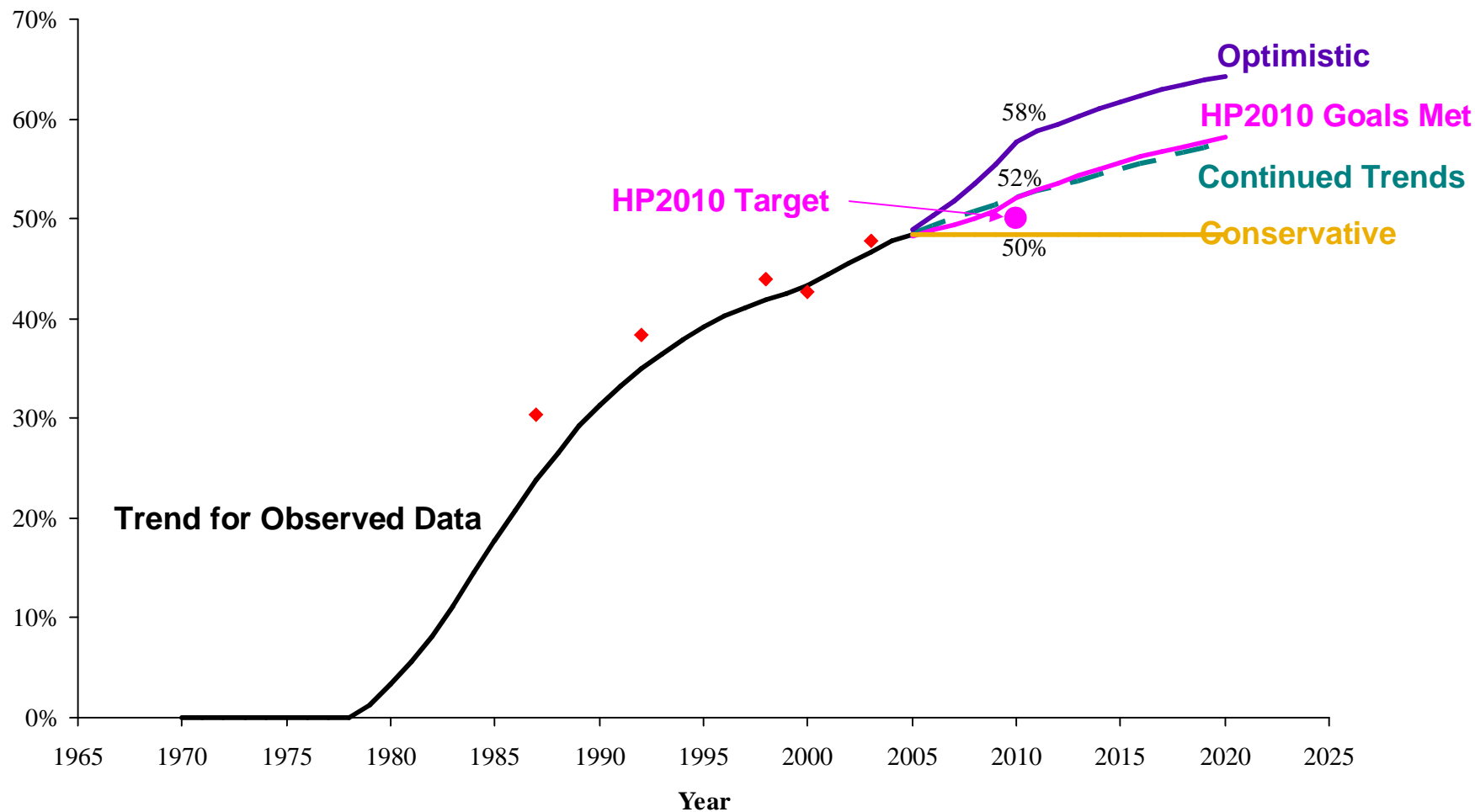
Percent of White Men (Age 25-84) who are Obese (BMI ≥ 30 kg/m²) (RR=1.5)



Data Source: NHANES Surveys

Screening Example: Endoscopy

Percent of Adults (Age 50+) Who Ever Had a Colorectal Endoscopy (sigmoidoscopy or colonoscopy)

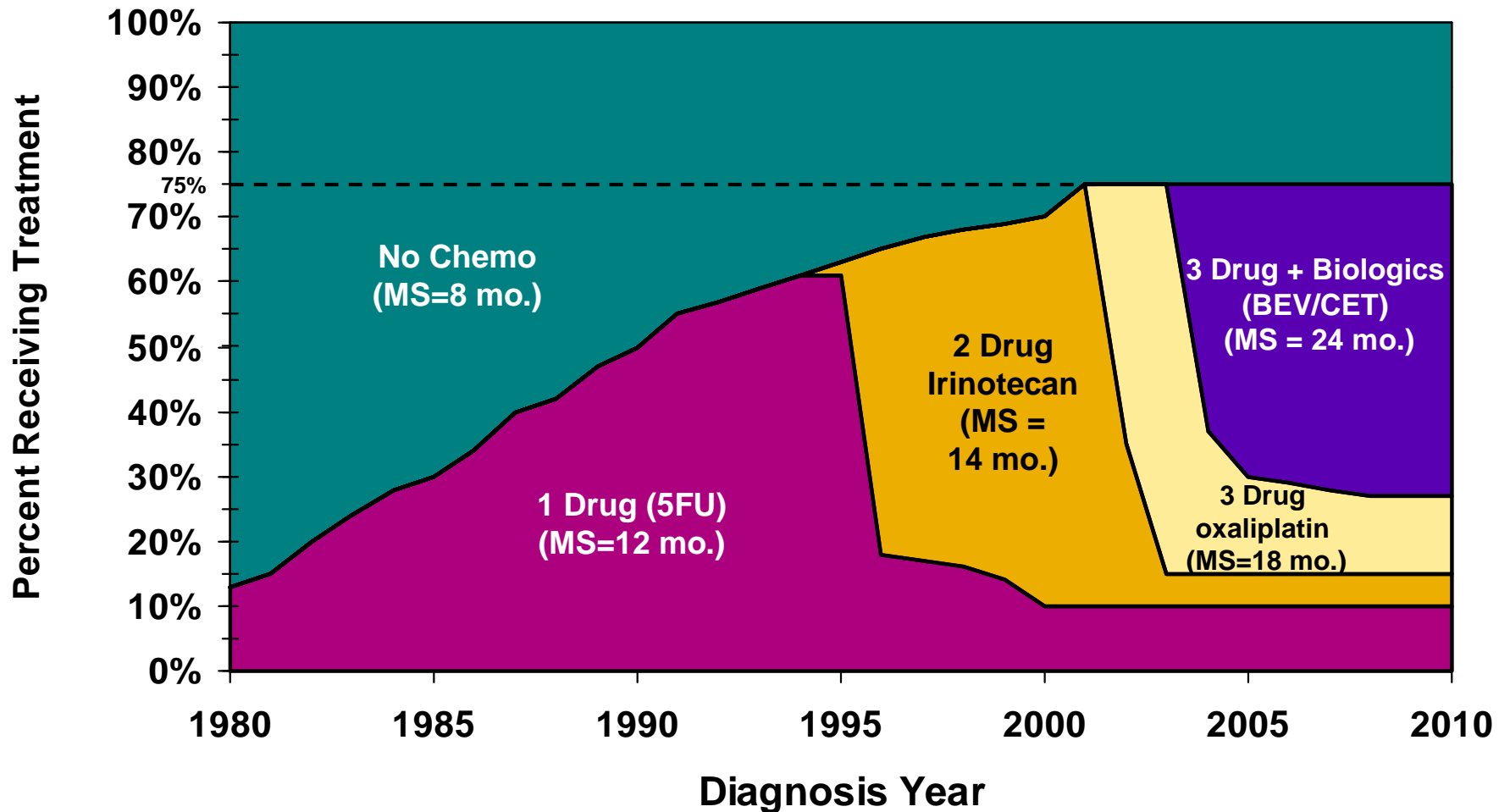


Data Source: NHIS

Treatment Example: Stage IV Treatment in White Men 70-74

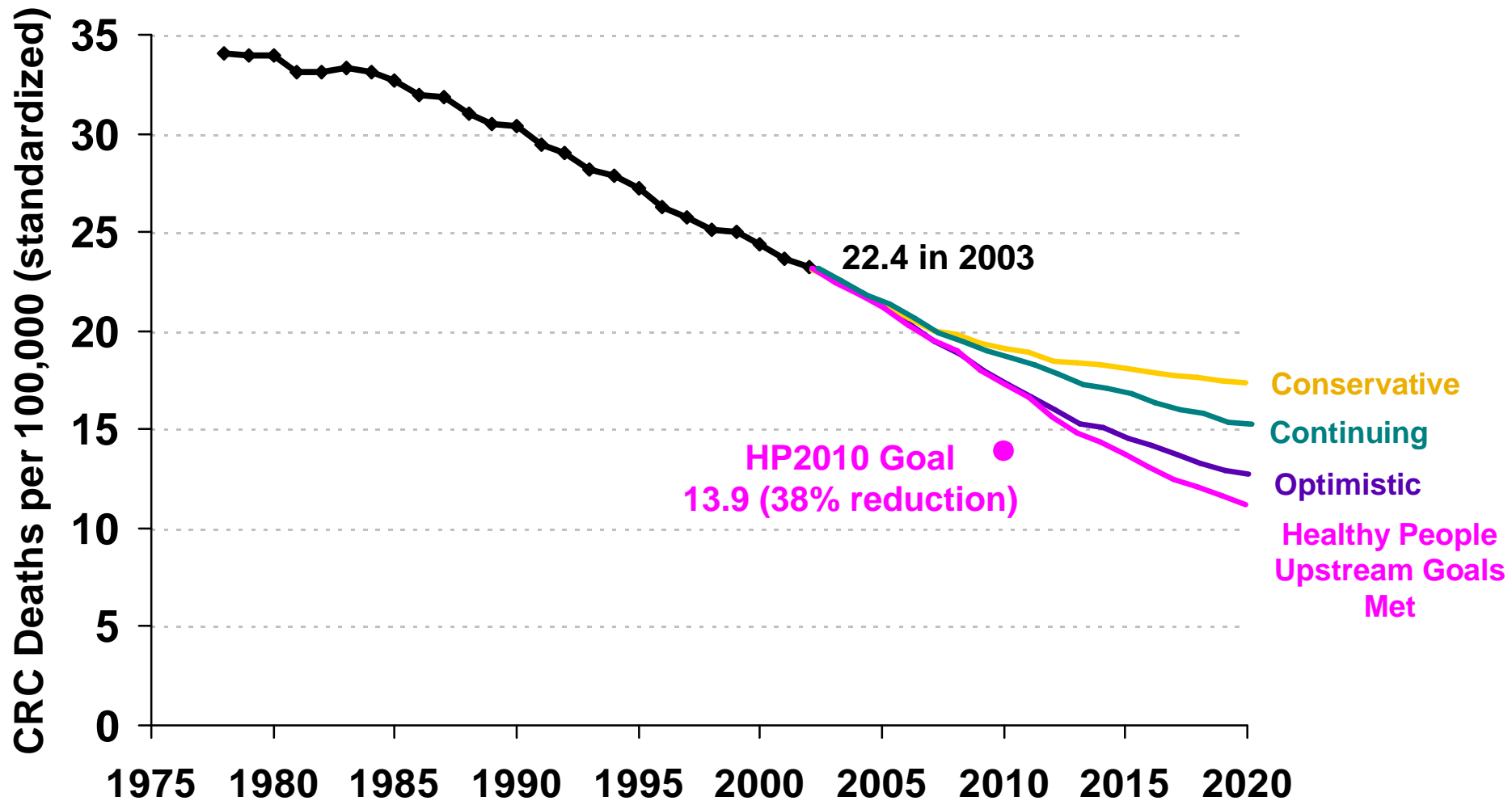


Continued Trends

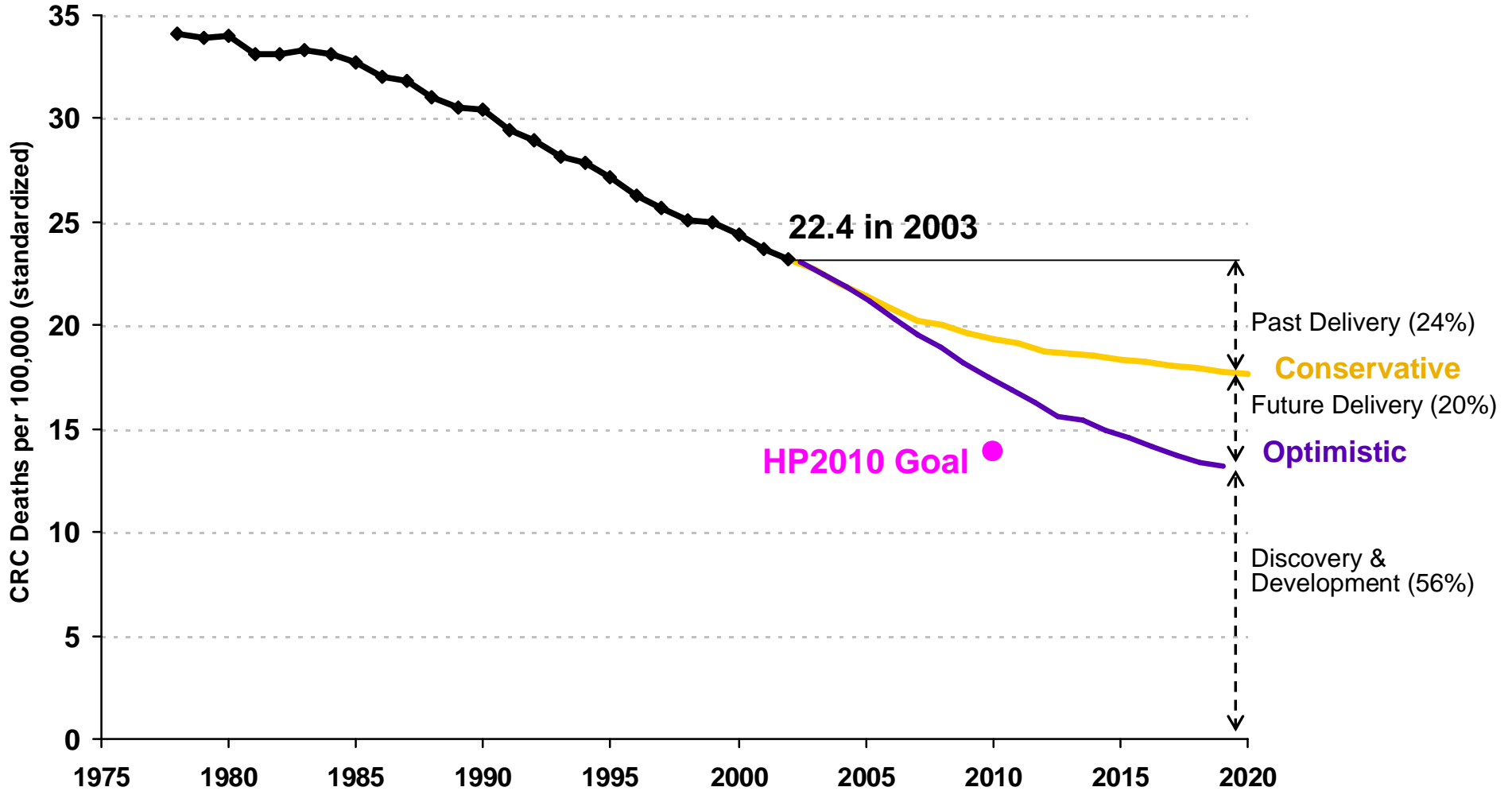


Data Sources: SEER Based Patterns of Care Studies, SEER-Medicare (older patients), NCCQ survey (5 metro areas)

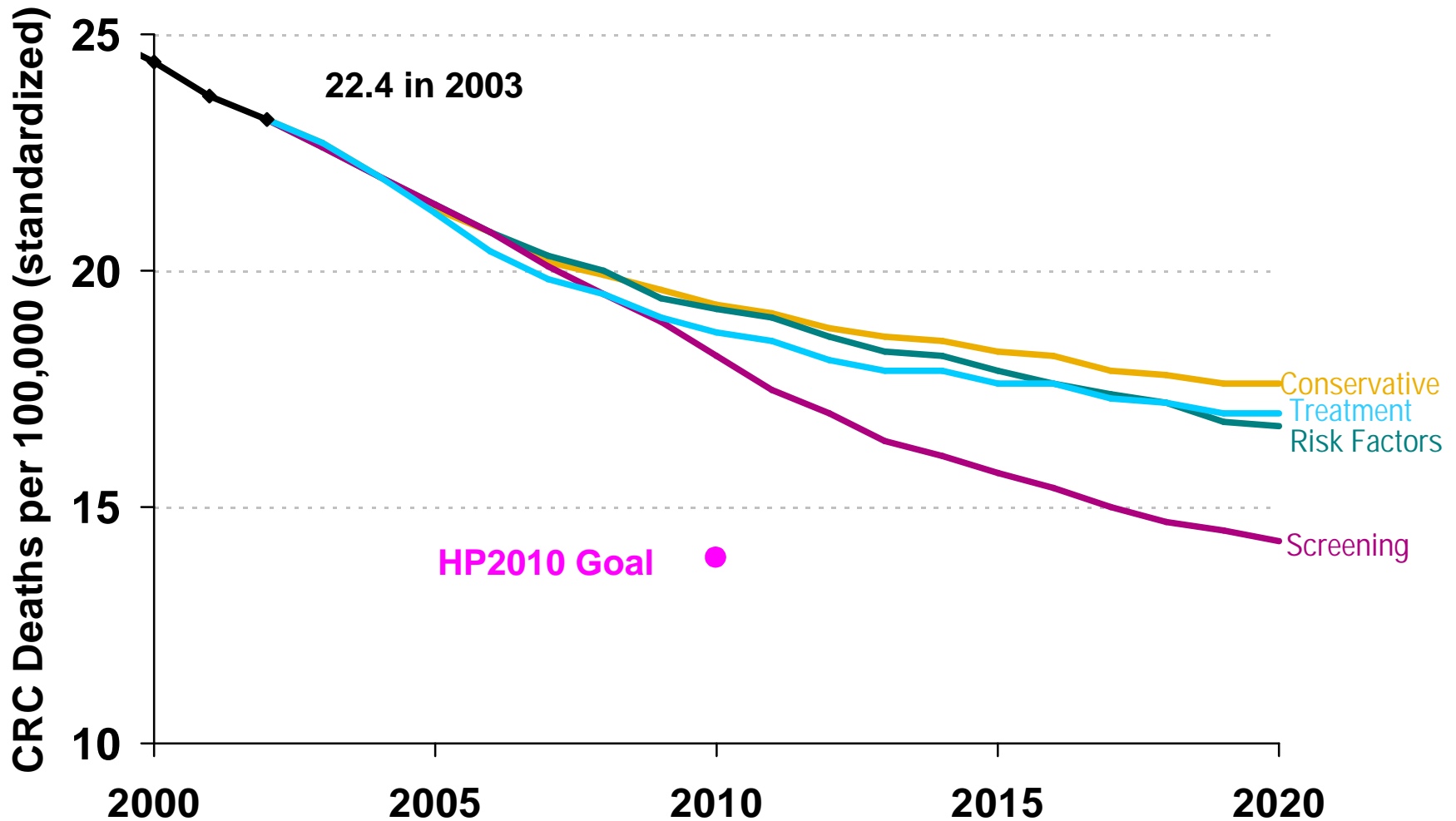
If we meet all the upstream goals, how close can we come to meeting the mortality goal?



What is the Potential Mortality Impact of Meeting Optimistic Goals for the Delivery of Screening, Treatment, and Prevention by 2020?



What is the contribution of screening, treatment and risk factors to the mortality decline?



Cancer Mortality Projections Web Site Under Development



National Cancer Institute

U.S. National Institutes of Health | www.cancer.gov

Cancer Mortality Projections

Modeling the impact of cancer control efforts on US cancer mortality

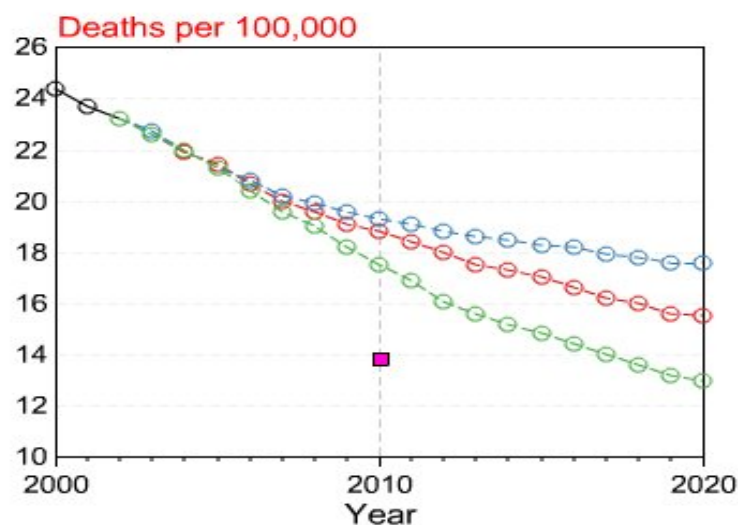
SEARCH

Home About CISNET Modeling **Colorectal Cancer** Breast Cancer

- Colorectal Home
- Overview
- Results
- Simulation Models
- Risk Factors
- Screening
- Treatment
- Interactive Graphs

Colorectal Interactive Graphs - MISCAN Model

Projected colorectal cancer mortality rate, by calendar year and scenario

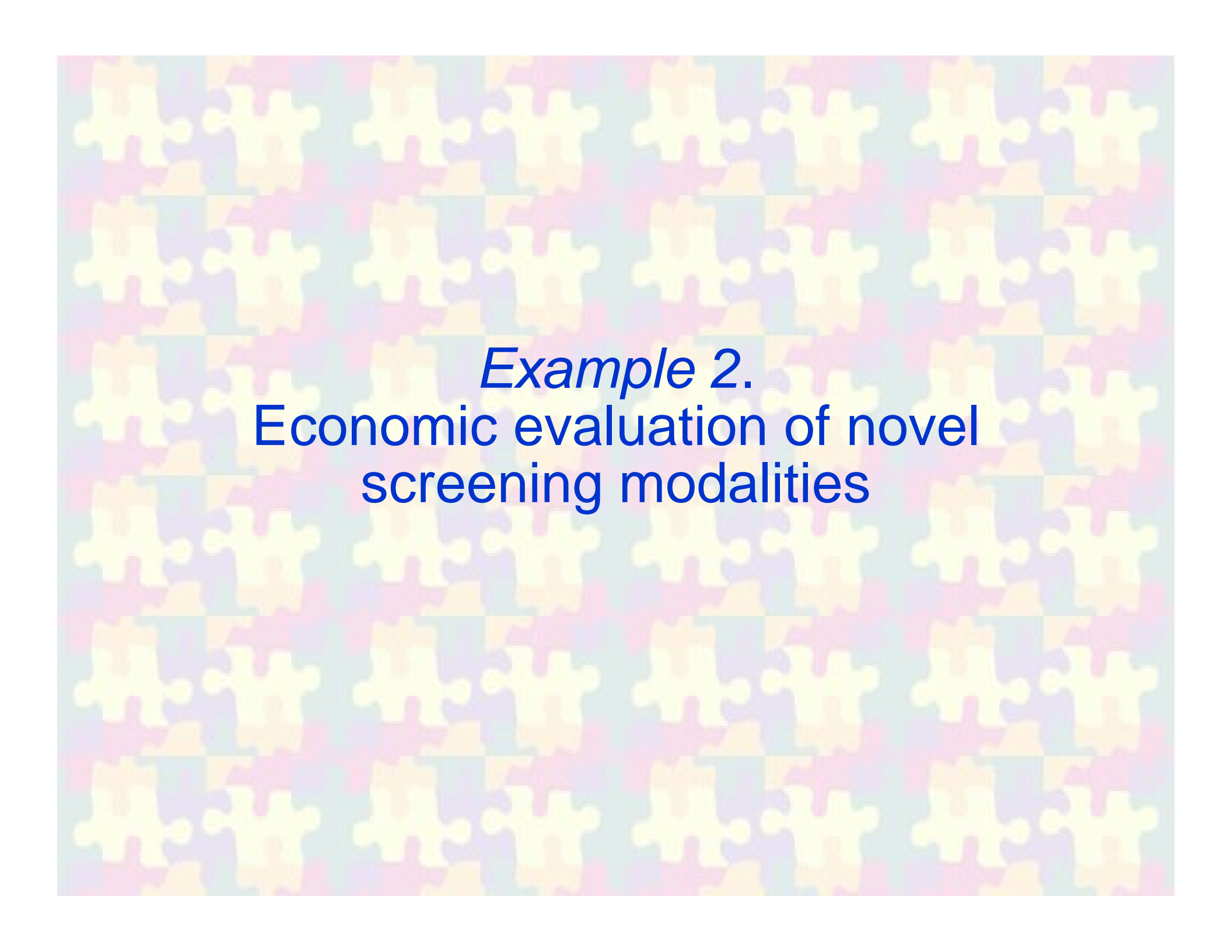


- HP 2010 Goal
- ⊖ US Vital Statistics
- ⊖ MISCAN : PT - ALL
- ⊖ MISCAN : PT - 2004
- ⊖ MISCAN : DFG - ALL

* Age-adjusted to the 2000 standard population using age groups <1y, 1-4y, 5-14y, 15-24y, 25-34y, 35-44y, 45-54y, 55-64y, 65-74y, 75-84y, 85+y
 † Treatment-related goals were not included in the Healthy People 2010 goals. We included treatment goals to evaluate the potential impact on colorectal cancer mortality

- Sex**
 Both Men Women
- Race**
 All Black White

- Baseline**
- Continuation of current trends (PT ALL)
 - Continuation of 2004 levels (PT 2004)
- Difficult but Feasible Goals Met**
- All difficult but feasible goals met (DFG ALL)
 - All Risk Factors (DFG RF)
 - Screening (DFG SCR)
 - Risk Factors and Screening (DFG RF-SCR)
 - Treatment is best available (DFG TT-TD)
 - More treated with best available (DFG TT)
 - More patients are treated (DFG TD)
 - Body Mass Index (BMI) (DFG ODA)
 - Multivitamin (DFG MV)
 - Smoking (DFG SMK)
- Healthy People 2010 Goals Met**
- All HP2010 goals met (HPG ALL)
 - All Risk Factors (HPG RF)
 - Screening (HPG SCR)
 - Risk Factors and Screening (HPG RF-SCR)
 - Body Mass Index (BMI) (HPG ODA)
 - Multivitamin (HPG MV)
 - Smoking (HPG SMK)



Example 2.
Economic evaluation of novel
screening modalities

What CMS reimbursement for a new FOBT test?

\$4.50



Guaiac FOBT

\$ to be determined



Immunochemical FOBT

MISCAN Microsimulation of Medicare population



- Program of annual FOBT screening for Medicare recipients
- Program initiated in 2000 and continued for 30 years
- All persons ages 65 to 79 to receive annual FOBT screening
- Health effects and costs followed for lifetime
- *Sensitivity analyses*

Sensitivity and Specificity of Fecal Occult Blood Tests



<i>FOBT TEST</i>	<i>Sensitivity*</i>			<i>Specificity*</i>	<i>Base</i>
	<i>CRC</i>	<i>Lg AD</i>	<i>Sm AD</i>		
Hemoccult II	40%	10%	5%	98%	BASE
Hemoccult SENSA	70%	17%	9%	92.5%	BASE
Immunochemical FOBT (1)	70%	17%	9%	98%	New test
Immunochemical FOBT (2)	70%	17%	9%	95%	New test

*Literature review

Results



- Determined threshold costs for which iFOBT same cost-effectiveness as Hemoccult II and Sensa

<i>SCENARIO</i>	<i>Threshold Cost</i>	
Hemoccult II 40_10_05_98 \$4.50	IFOBT 70_17_09_98	\$11.28
	IFOBT 70_17_09_95	-\$4.22
Hemoccult SENSA 70_17_09_92.5 at \$4.50	IFOBT 70_17_09_98	\$32.93
	IFOBT 70_17_09_95	\$17.25

Policy result from this study

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- Immunochemical FOBT approved for reimbursement
- Cost effectiveness estimate used in setting reimbursement fee



\$22.22



Example 3.

Impact of public program promoting
colorectal cancer screening

MISCAN Microsimulation of Colorectal Cancer Screening Program Starting in Ontario in 2008

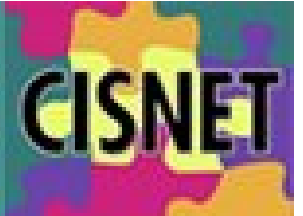


- Program of biennial FOBT screening for ages 50 to 74 in Ontario for average risk population
 - ◆ FOBT kits through Primary Care Physicians, Pharmacies, or 800 number
- Colonoscopy screening for First Degree Relatives of CRC cases



Ontario

MISCAN Microsimulation of Colorectal Cancer Screening Program Starting in Ontario in 2008

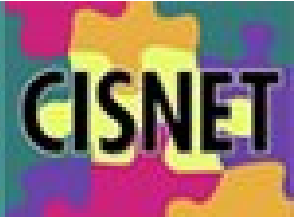


- Estimate of Resources required over 20 years period
 - ◆ Number of screening tests
 - ◆ Number of diagnostic and surveillance colonoscopies

- Project incidence and mortality impact of screening program – 5, 10, 15, 20, 25, 30 year effects.

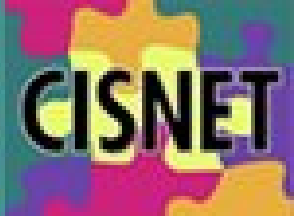
- Build capacity to use microsimulation modeling for Ontario researchers.

MISCAN CRC model reconfigured to Ontario population



- Population in 2005 by age-group
- Life tables (all cause mortality) per 5-year birth-cohort from births 1900-2000
- Age-specific incidence of colorectal cancer in 2005
- Stage Distribution of colorectal cancer in 2005
- Relative Survival by Colorectal Cancer Stage
Or *Age-specific mortality of CRC in 2005*
- Screening levels in population at risk 2000-2005

Thank you



➤ Memorial Sloan-Kettering and Erasmus MC (The Netherlands)

- ◆ Erasmus: Iris Lansdorp-Vogelaar*, Marjolein van Ballegooijen, Rob Boer, Janneke Wilschut, Dik Habbema
- ◆ MSKCC: Ann Zauber, Sid Winawer, Deb Schrag