Cost-effectiveness analysis of non-invasive FFR_{CT} for stable chest pain evaluation

A comparison to coronary CTA and functional testing based on the PROMISE Trial

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Disclosures

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Low Dx Yield of Fx Testing in Elective ICA

- NCDR - 376,430 patients with de novo chest pain 2005-2007

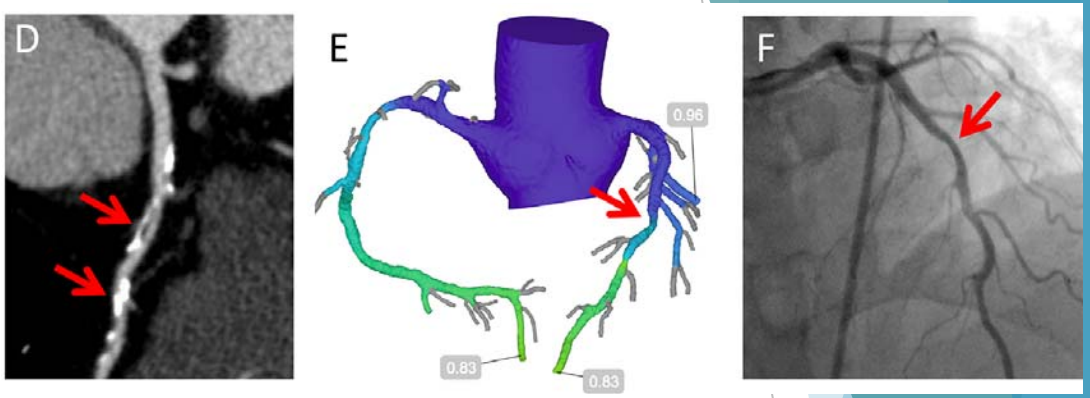
Index test	All patients	No stress test	Positive test result	Equivocal test result	Negative test result
All patients	376,430	16%	68%	4%	12%
No CAD	233,515 (62%)	65%	59%	73%	71%
CAD	**142,912 (38%)**	**35%**	**41%**	**27%**	**29%**

38% obstructive CAD (≥70%; ≥50% LM)

Patel, MR, NEJM 2010

FFR_{CT}

- Remote calculation of lesion specific FFR based on resting standard coronary CTA



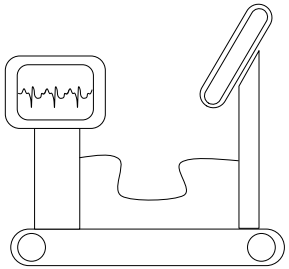
False positive anatomic assessment

Can FFR_{CT} improve patient selection for ICA and outcomes?

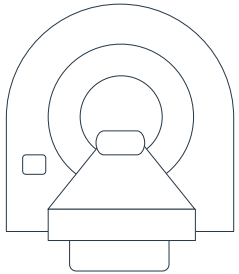
Objective

To compare cost effectiveness of 3 strategies of noninvasive diagnostic testing in patients with stable chest pain.

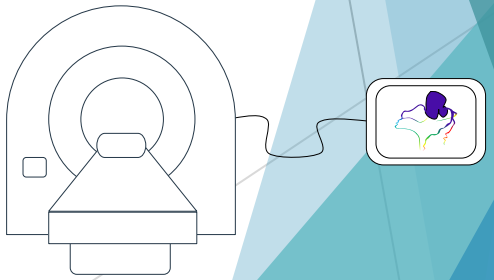
Functional testing



Coronary CTA



Coronary CTA+CT FFR



Markov Decision Model of Stable Chest Pain

Lifetime Simulation

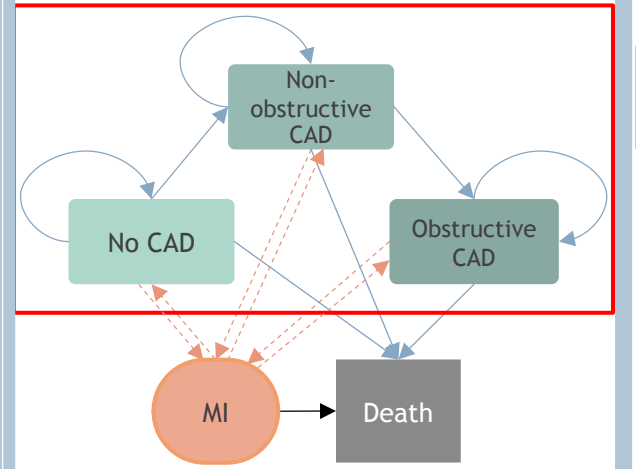
Model population: PROMISE

Each Patient enters the simulation 100 times

Testing Strategies

- Functional Testing
- Coronary CTA
- Coronary CTA+FFR$_{CT}$

Health States



- Mathematical Modeling of transition on monthly basis
- Specific Probability of MACE and Death for each health state

Model Outputs

- Downstream Testing
- Treatment
- Health Outcomes
- Costs
- Life Time Cost-effectiveness

What drives decision making ?

1. **In whom to calculate FFR_{CT}:** intermediate CAD (30-69% stenosis)
   - 31% of the model population
2. **Who goes to ICA?**
   I. Functional testing: reversible myocardial ischemia;
   II. Coronary CTA: 70% in >1 vessel or 50% CAD in LM;
   III. FFR_{CT} : <0.80
3. **MACE risk**: HR based on age and sex specific CAD status - CONFIRM registry
4. **Treatment effects**
   1. statin treatment – 20 to 30% risk reduction
   2. Detection of non-obstructive CAD – statin treatment w benefits
5. **Costs:** FFR_{CT} CMS ($1450)

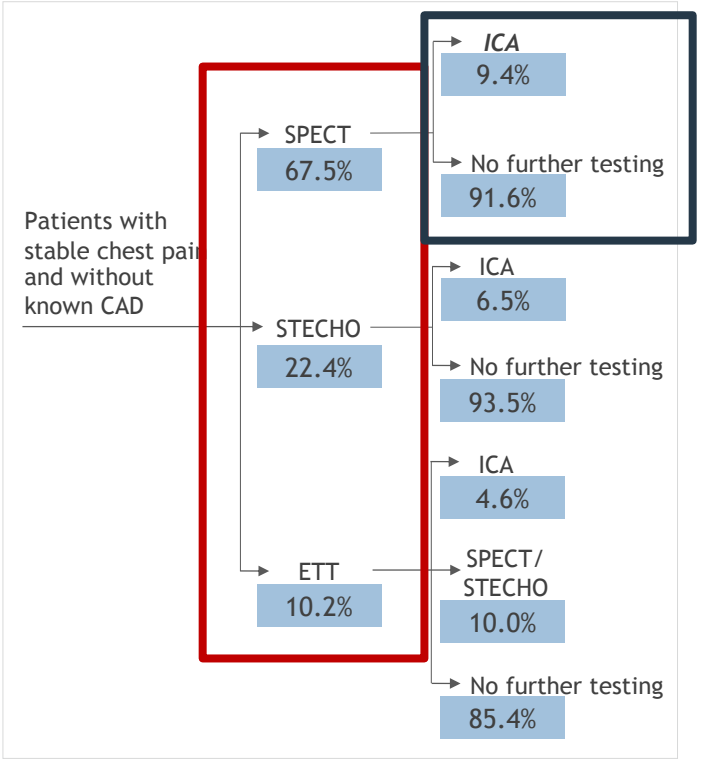
Stable Chest Pain Population referred for noninvasive dx testing*

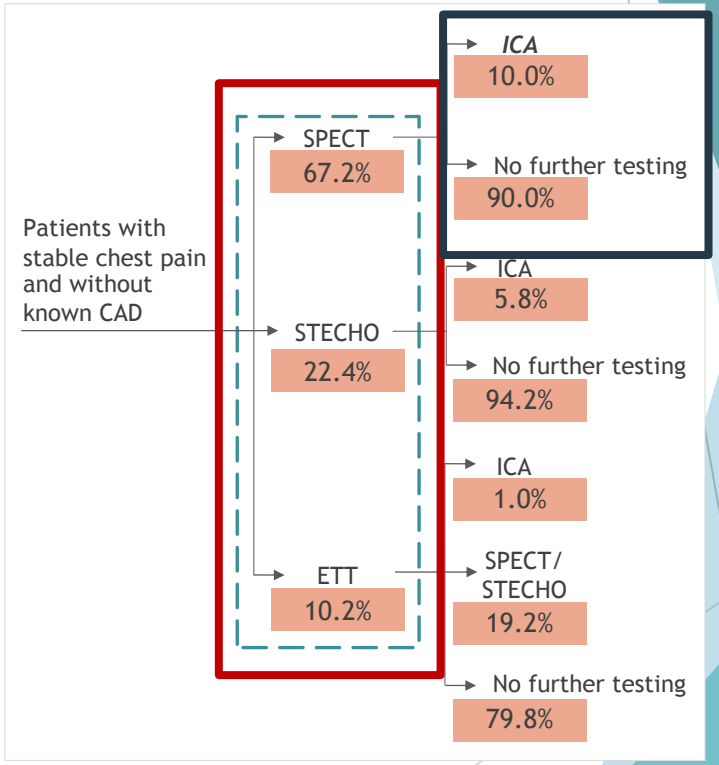
Variables	N=1,000,300
Mean age (years), median (IQR)	60.0 (54.4-65.9)
Female sex, n (%)	5,270 (52.7)
Mean Number of risk factors	3
Atypical angina	7,773 (77.7)
Mean Probability of obstructive CAD (Diamond and Forrester)	**53.3%**
Normal Tests	
Coronary CTA	33%
Functional Testing	78%
Myocardial Ischemia, CAD>50%	**10%**
Composite CV Death/MI over a median follow-up of 25 months	**1.6%**

*PROMISE, NEJM 2015, 192 North American sites, 10003 patients

Test distribution and downstream testing at 60 days

Functional testing





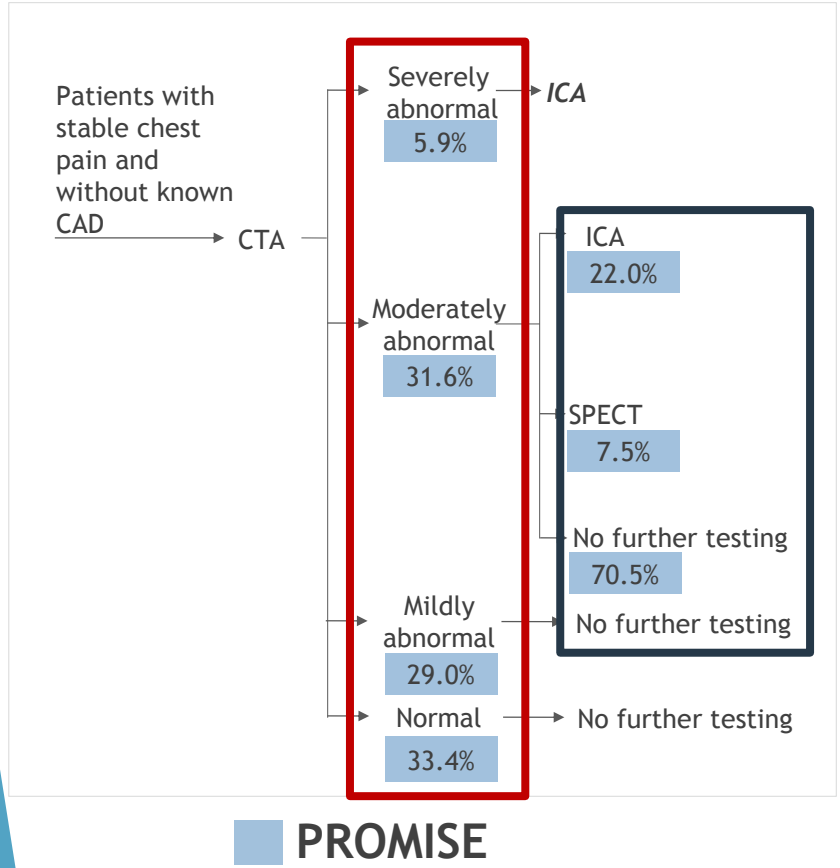
PROMISE

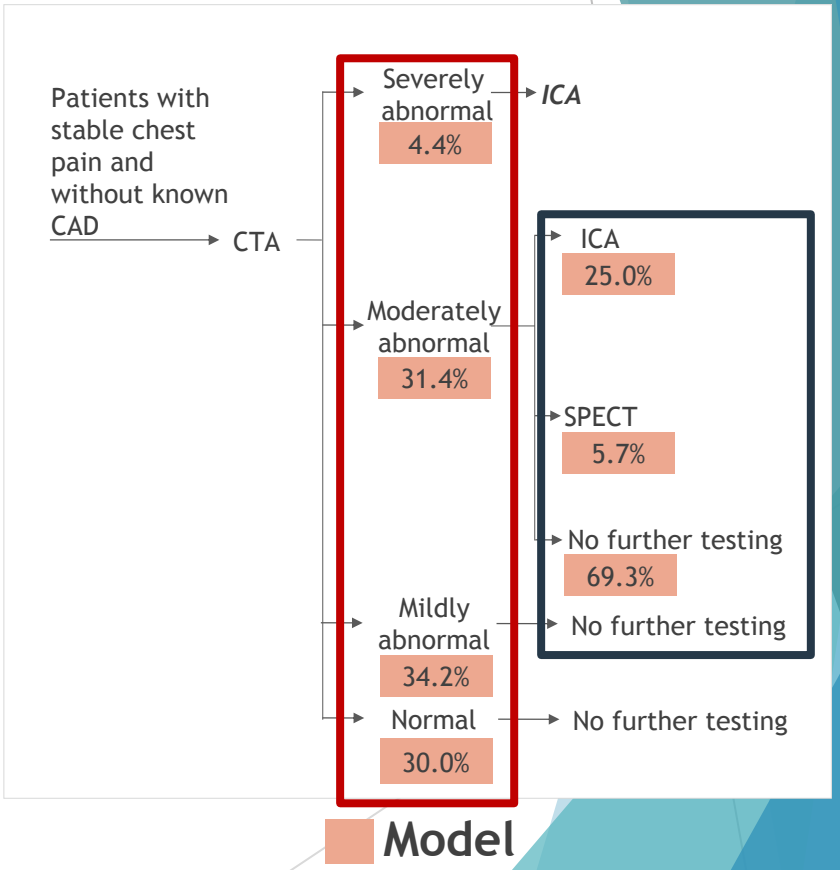
Model

Individual probability based on risk score*

Test results and downstream testing at 60 days

Coronary CTA



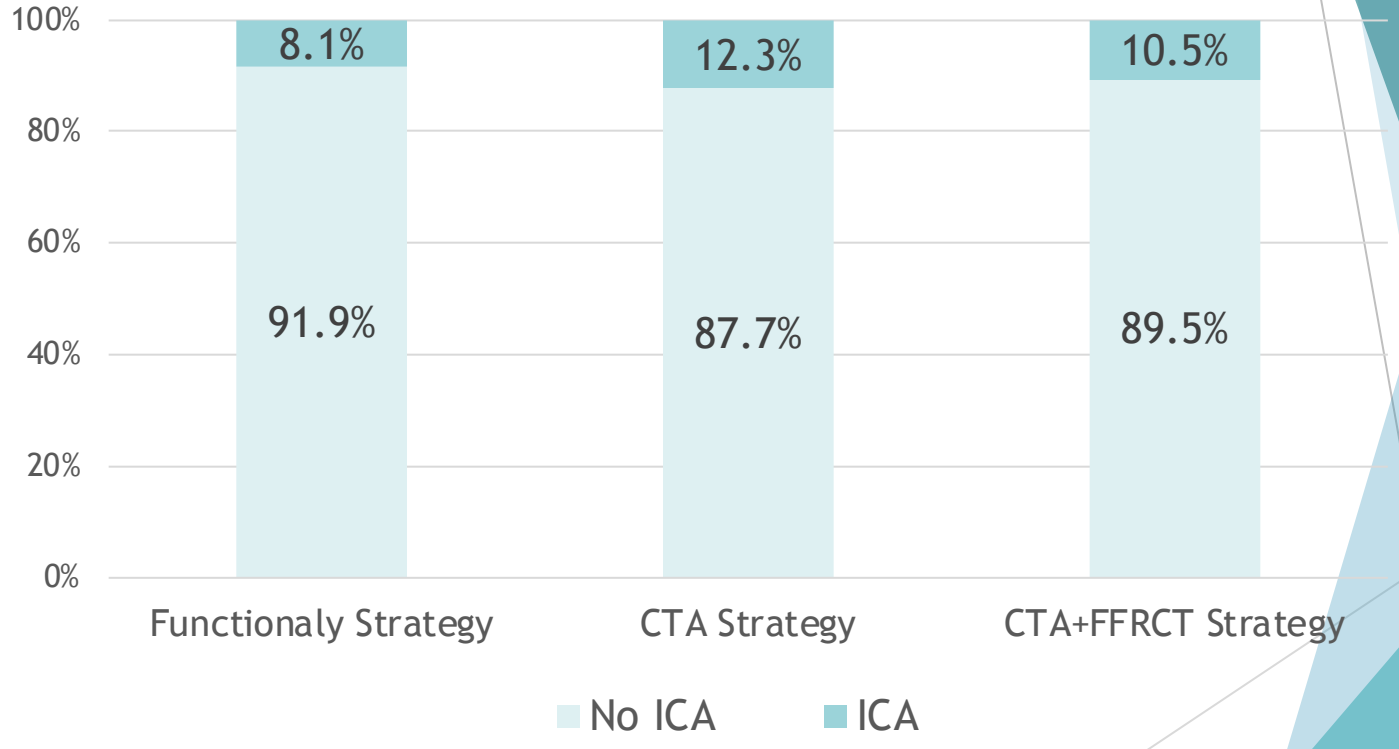


Markov Model accurately simulates downstream testing, intervention, cost, and MACE

	CTA Strategy		Functional Strategy	
	Observed	Simulated	Observed	Simulated
	N=4,996	N=499,600	N=5,007	N=500,700
60 days				
ICA (%)	12.2	12.3	8.1	8.2
Coronary Revascularization	6.2	6.4	3.2	3.3
Cost in US $	$2,494[21]	$2,546	$2,240[21]	$2,189
2 years				
Composite MACE Death/MI (%)	2.1	2.3	2.2	2.4

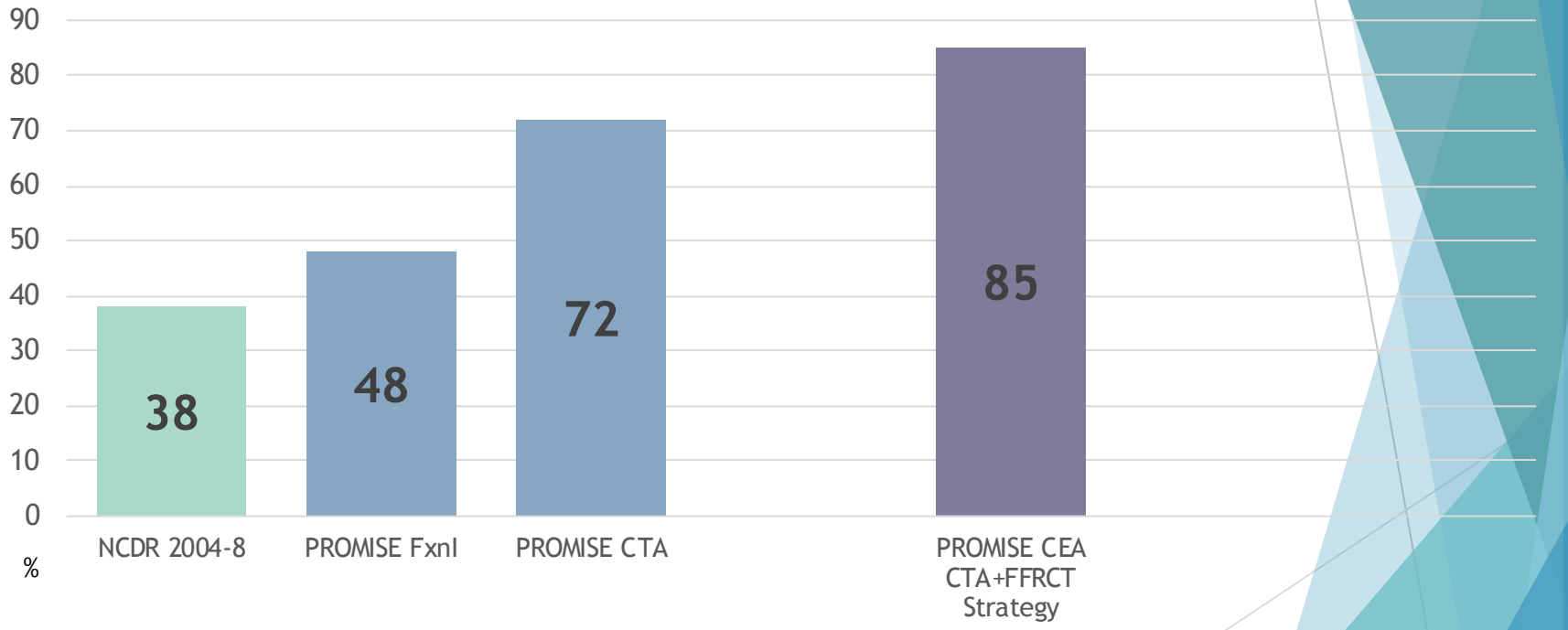
Simulation of the Effect of FFR_{CT}

Patient Selection for ICA



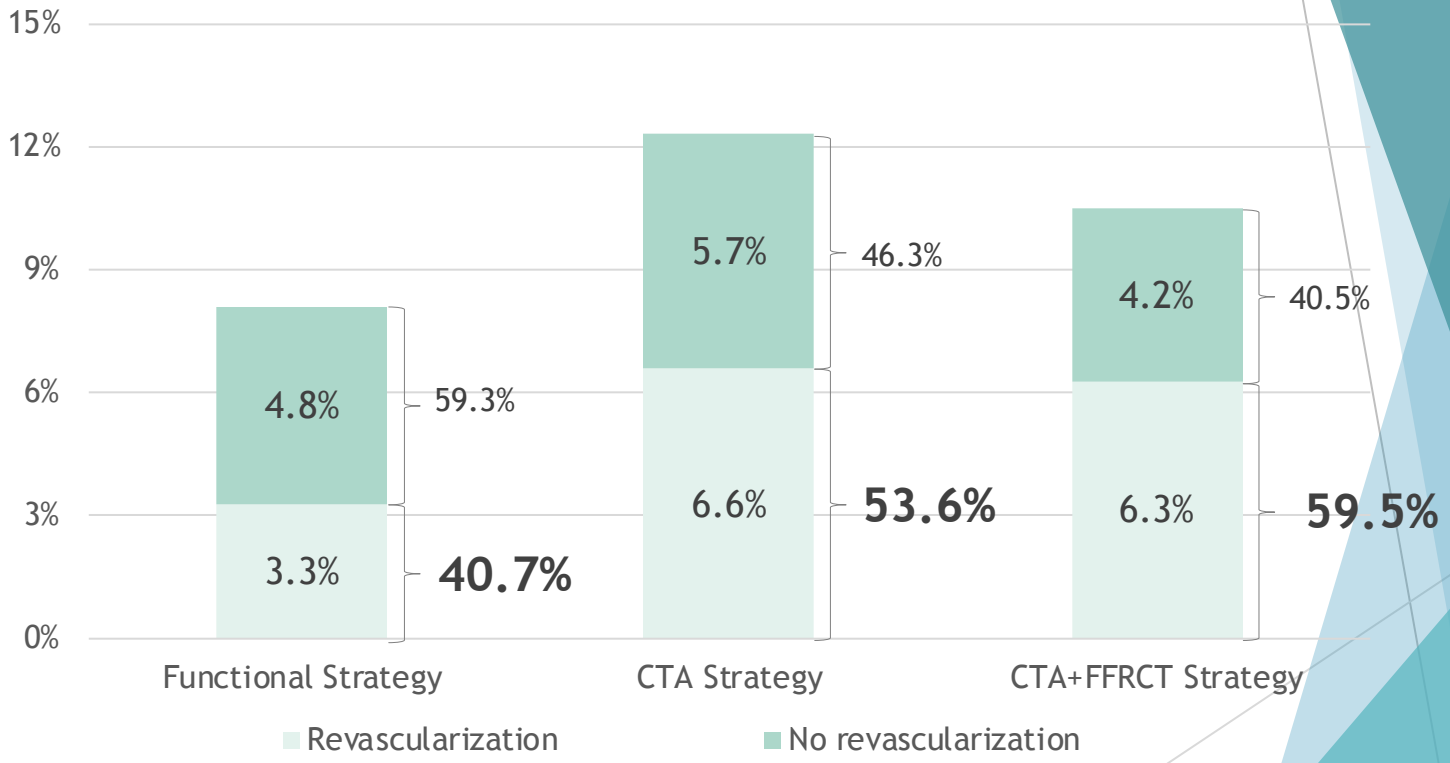
Applied to PROMISE, CTA+ FFR_{CT} would have saved 14.6% (n=90/615) of dx ICA

Yield of Dx Testing



% of patients with obstructive CAD (>50%) in ICA

ICA Yield



% of patients undergoing coronary Revascularization

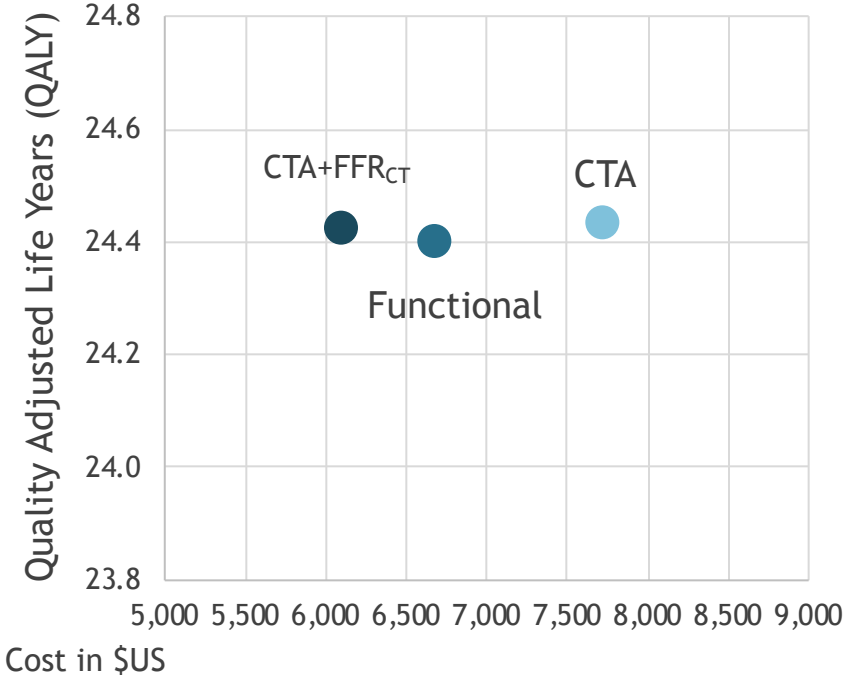
Five Year Results

	2 years			5 years		
Index test	**Coronary CTA**	**Functional**	**CTA+FFR$_{CT}$**	**Coronary CTA**	**Functional**	**CTA+FFR$_{CT}$**
Revascularization, %	**6.6**	**3.6**	**6.3**	**6.8**	**4.2**	**6.5**
PCI	4.6	2.9	4.3	4.7	3.4	4.4
CABG	2.0	0.7	2.0	2.1	0.8	2.1
MACE*, %	**1.3**	**1.3**	**1.3**	**3.5**	**3.6**	**3.5**

*CHD death and myocardial infarction

Similar health outcomes, more revascularization over time after functional testing

Lifetime Cost-effectiveness*



- **FFR_{CT} less costly and more effective than functional testing strategy**

(dominant/cost effective)

- **FFR_{CT} less costly than coronary CTA and marginally less effective**

(cost saving)

*stable across a number of sensitivity and subgroup analyses

Limitations

- Scientific evidence limited for some modeling assumptions (gold standard QCA, treatment of CAD)
- Model only considers effect of statin treatment as being different between strategies
- No modeling of adherence to medical therapies

Conclusions

Stable Markov Model with accurate simulation of the results of the PROMISE Trial

Compared to functional testing and anatomic assessment alone, supplementing coronary CTA with FFR_{CT} results in

1. Highest yield of dx testing for obstructive CAD (86%)
2. Highest yield of ICA (revascularization-to-ICA ratio) (60%)
3. Long term: cost-effective (functional testing) or cost-saving (coronary CTA alone)

Thank you!