

A Scoring System for CTO PCI: Evidence Based Approach

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CTO Scoring

- **“When you want to do something you find a way, when you don’t want to do something you find excuses.”**
 - Jim Rome
- **If it is indicated and you can’t or don’t want to do it refer the patient**

Underutilization of CTO PCI

- Risk Treatment Paradox

	rSS = 0 (n = 1,084)	rSS >0–2 (n = 523)	rSS >2–8 (n = 578)	rSS >8 (n = 501)	p Value All Groups
Baseline SYNTAX score	7.5 ± 5.6	9.3 ± 6.1	12.6 ± 6.9	21.7 ± 8.6	<.001
Residual SYNTAX score	0	1.5 ± 0.5	5.2 ± 1.6	15.8 ± 6.5	<.001
Delta† SYNTAX score	7.3 ± 5.4	7.5 ± 6.1	6.9 ± 6.3	5.7 ± 6.4	.15

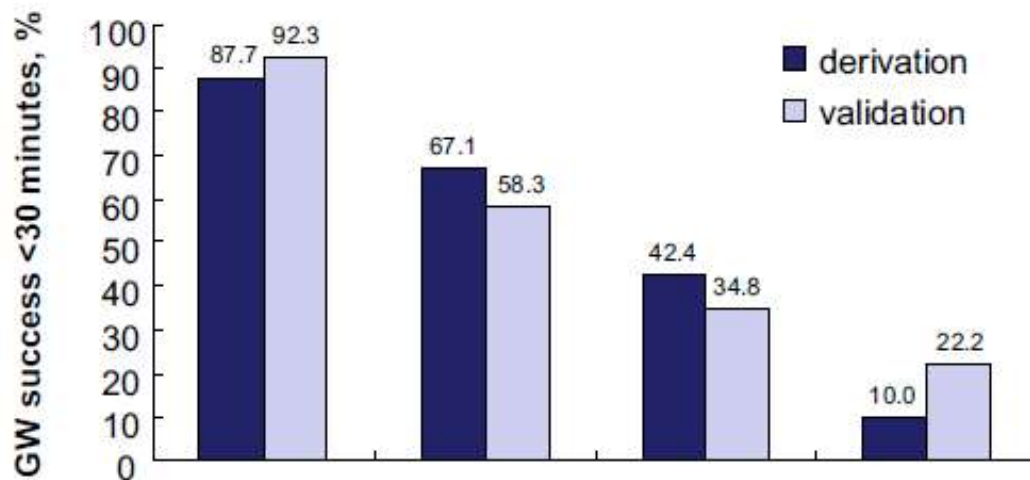
- Untreated Lesions

	rSS >0–2 (n = 523)	rSS >2–8 (n = 578)	rSS >8 (n = 501)	p Value All Groups
Severe calcification	0 (0%)	10 (1.7%)	59 (11.8%)	<0.001
Chronic total occlusion	1 (0.2%)	58 (10.0%)	216 (43.1%)	<0.001
Bifurcation/trifurcation	0 (0%)	179 (30.9%)	287 (57.3%)	<0.001
Aorto-ostial lesion	1 (0.2%)	4 (0.7%)	14 (0.3%)	<0.001
Lesion length >20 mm	3 (0.6%)	143 (24.7%)	351 (70.1%)	<0.001
Small vessel/diffuse disease	409 (78.2%)	303 (52.4%)	264 (52.7%)	<0.001

CTO Scoring

- **Potential Uses**
 - Case selection for the operator vs triage
 - Informed consent
 - **Quality** (observed to expected)
 - Success, efficiency, complications
- **Applicability**
 - Valid to you and your patients (do they measure intended outcome?)
 - Similar patients
 - Similar procedures

CTO Scoring Systems for Efficiency-JCTO



Risk groups: Easy Intermediate Difficult Very difficult
J-CTO score: 0 1 2 >=3

Patient number	329	65	82	92	90
derivation	329	65	82	92	90
validation	165	26	48	46	45

Variables in Model

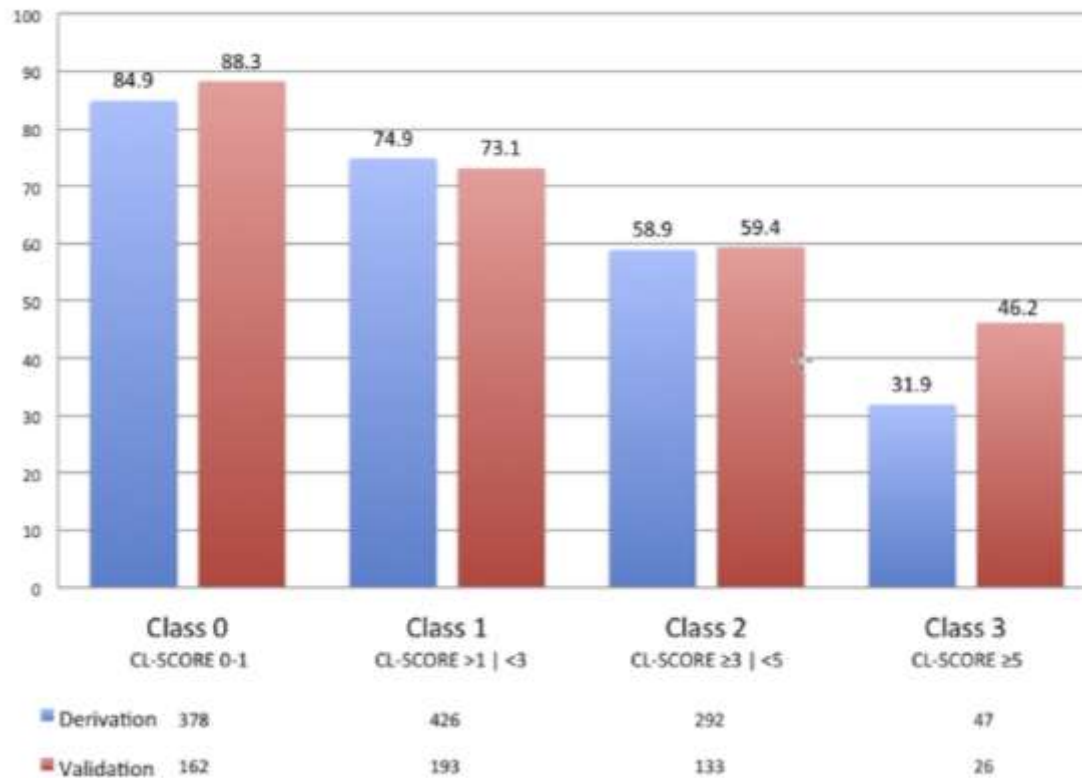
Blunt stump
Bending
Calcification
Length>20
Retry

Validation Set <30min crossing

- 0 Easy (92.3%)
- 1 Intermediate (58.3%)
- 2 Difficult (34.8%)
- ≥3 Very difficult (22.2%)

CTO Scoring Systems for Success-CL

FIGURE 1 Procedural Success Rate According to CL-Score Value in the Derivation and Validation Groups



Variables in Model

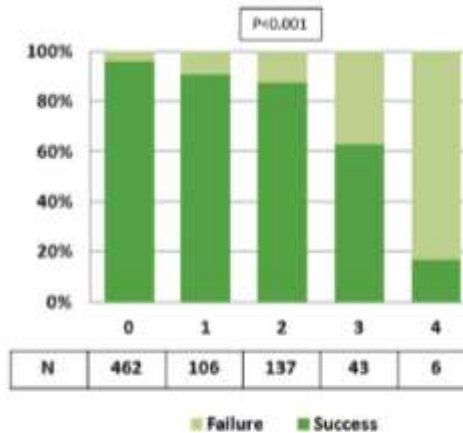
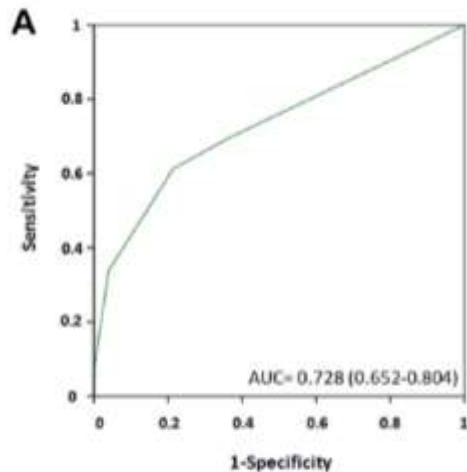
	OR	Score
Severe calcified lesion	2.72	+2
Previous CABG	2.49	+1.5
Lesion length ≥20 mm	2.04	+1.5
Previous MI	1.60	+1
Blunt stump	1.39	+1
Non-LAD CTO location	1.56	+1

Validation Set Success

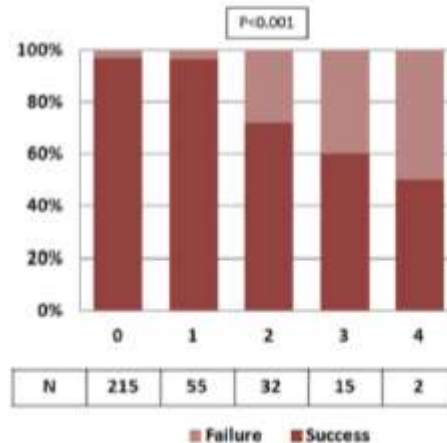
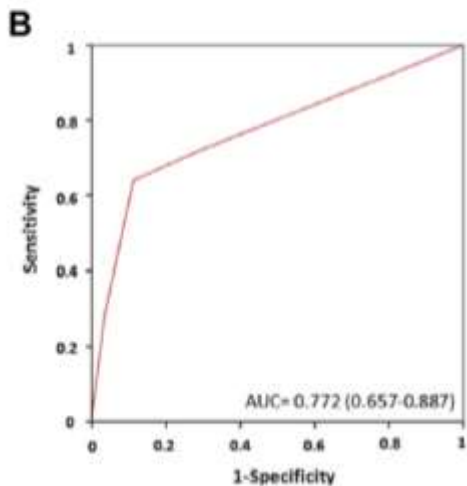
- 0-1 Easy (88.3%)
- 2 Intermediate (73.1%)
- 3-4 Difficult (59.4%)
- ≥5 Very difficult (46.2%)

CTO Scoring Systems for Success-ORA

FIGURE 6 Receiver-Operating Characteristic Curves and Relationship Between Procedures Categories and Technical Success



N	0	1	2	3	4
	462	106	137	43	6



N	0	1	2	3	4
	215	55	32	15	2

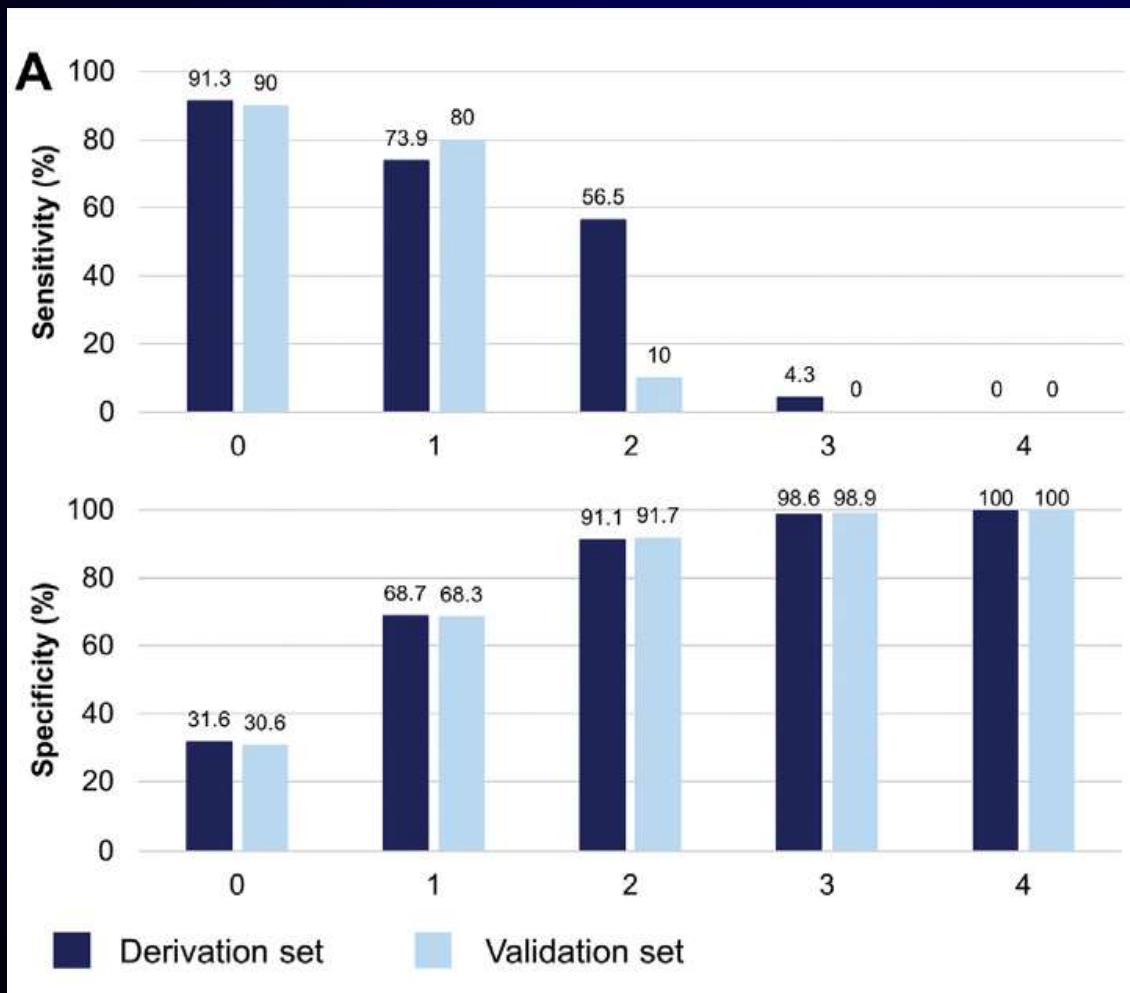
Variables in Model

Ostial
Rentrop<2
Age>75

Validation Set Success

0 Easy (96.8%)
1 Intermediate (96.4%)
2 Difficult (71.9%)
≥3 Very difficult (58.8%)

CTO Scoring Systems for Success-PROGRESS



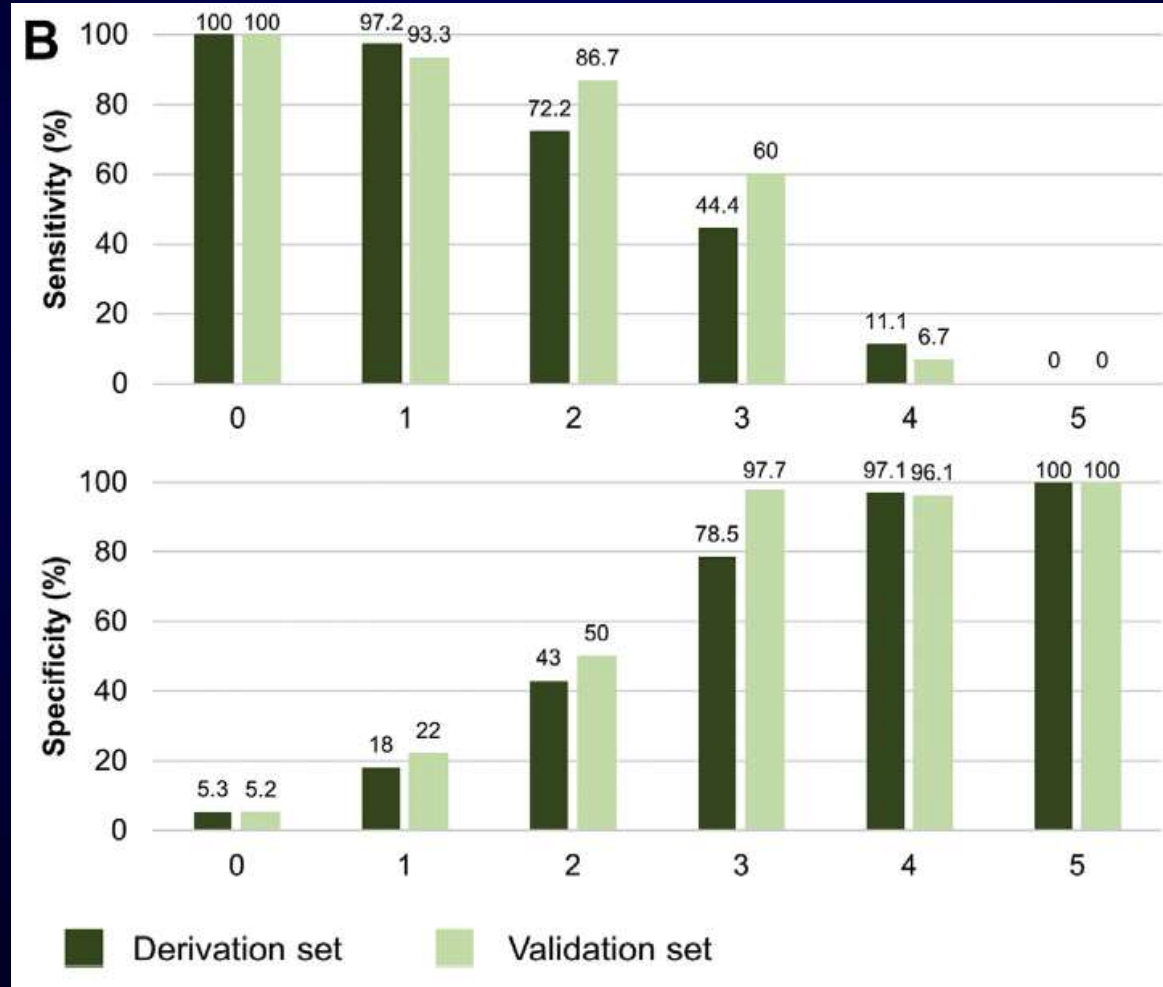
Variables in Model

Cap ambiguity
No collaterals
Tortuosity
LCX

Validation Set Success

- 0 Easy (98.2%)
- 1 Intermediate (97.5%)
- 2 Difficult (91.6%)
- ≥3 Very difficult (76.7%)

CTO Scoring Systems for Success-JCTO in PROGRESS



Practical Application- WWW.PROGRESSCTO.com

CTO Score Calculator

Patient initials:
JAG

Target vessel <input type="radio"/> LAD <input checked="" type="radio"/> LCX <input type="radio"/> RCA	Lesion calcification <input type="radio"/> None <input checked="" type="radio"/> Mild/moderate <input type="radio"/> Severe	Occlusion length <input type="radio"/> <20 mm <input checked="" type="radio"/> ≥20 mm
Ostial location <input checked="" type="radio"/> No <input type="radio"/> Yes	Proximal cap ambiguity <input type="radio"/> No <input checked="" type="radio"/> Yes	Stump <input type="radio"/> Tapered <input checked="" type="radio"/> Blunt
Proximal vessel tortuosity <input type="radio"/> None/mild <input checked="" type="radio"/> Moderate/severe (1 bend > 90° or 2 bends > 70°)	Bending (intra-lesion) <input checked="" type="radio"/> ≥45° <input type="radio"/> <45°	
Collateral filling <input checked="" type="radio"/> Restrop 2-3 <input type="radio"/> Restrop 1-2	Interventional collaterals <input checked="" type="radio"/> Present <input type="radio"/> Absent	
Age <input checked="" type="radio"/> <75 years <input type="radio"/> ≥75 years	Previous MI <input type="radio"/> No <input checked="" type="radio"/> Yes	

CL score	Score	Technical success
6.0	0 - 1.0	88.3%
	1.5 - 2.5	73.1%
	3.0 - 4.5	59.4%
	≥ 5.0	46.2%
<small>Alexander et al., JACC Cardiovasc Interv. 2013 Oct; 6:1090-8</small>		

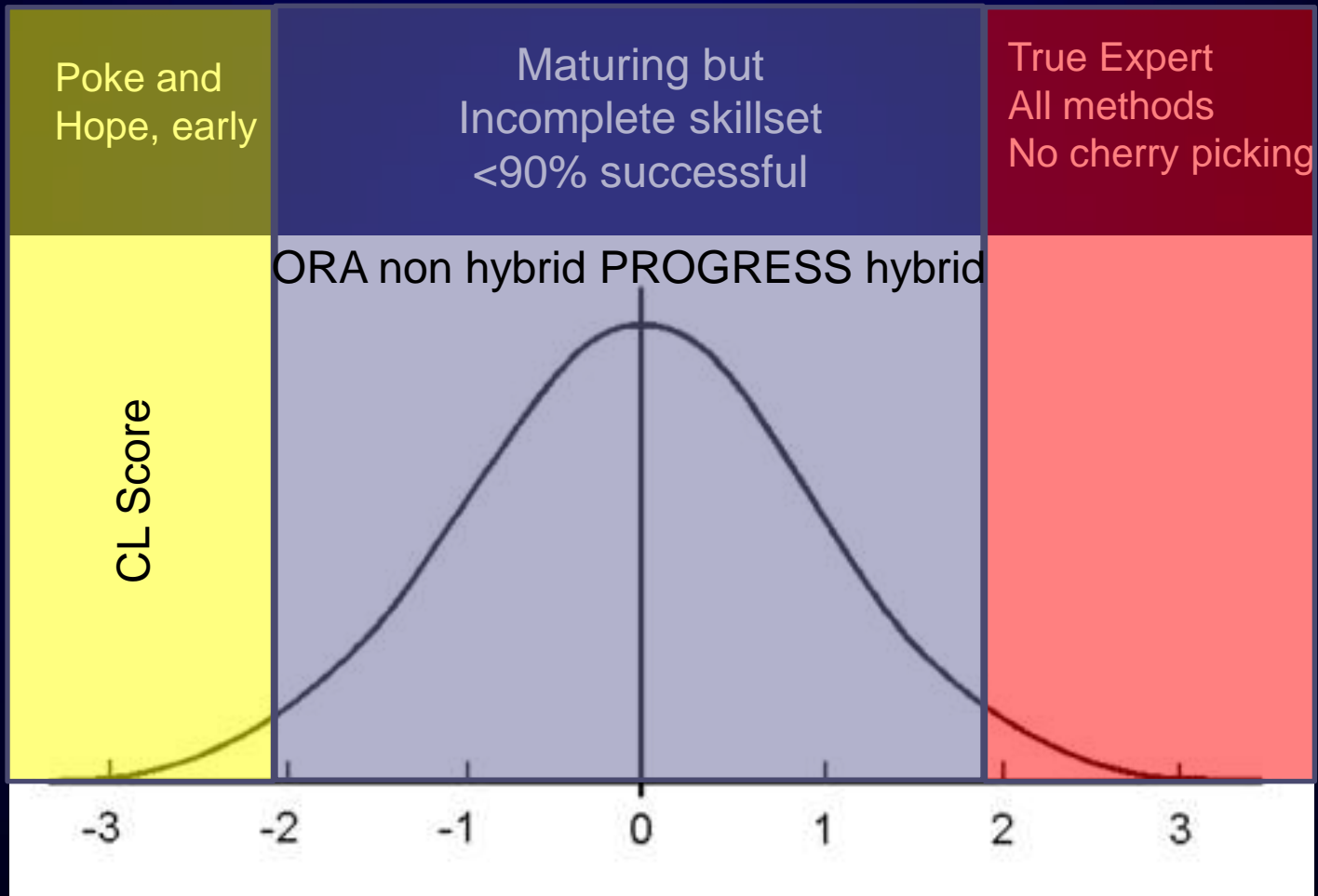
J-CTO score	Score	Probability of crossing in <30 minutes
4	0	92.3%
	1	58.3%
	2	34.8%
	≥ 3	22.2%
<small>Burton et al., JACC Cardiovasc Interv. 2011 Feb; 4:233-8</small>		

PROGRESS CTO score	Score	Technical success
3	0	98.2%
	1	97.5%
	2	91.6%
	≥ 3	76.7%
<small>Dzavazos et al., JACC Cardiovasc Interv. 2015 Apr; 11:1-8</small>		

ORA score	Score	Technical success
0	0	96.8%
	1	95.4%
	2	71.9%
	≥ 3	58.8%
<small>Gilbert et al., JACC Cardiovasc Interv. 2015 May; 8:911</small>		

46%-97% success
22% <30min wire time

Summary-Triage Use



Summary

- **Limitations**
 - Choose the one most applicable to you
- **Success prediction scores are useful for:**
 - Informing patients of likelihood of success
 - Quality
 - Triaging patients

Do not use them to decide whether or not to offer CTO PCI to a patient with a good indication