Less use of FFR

Why and how to overcome?

Nils P. Johnson, MD, MS, FACC

Associate Professor of Medicine
Weatherhead Distinguished Chair of Heart Disease
Division of Cardiology, Department of Medicine
and the Weatherhead PET Imaging Center
University of Texas Medical School at Houston
Memorial Hermann Hospital – Texas Medical Center
United States of America

Visiting cardiologist
Heart & Vascular Center
Catharina Hospital, Eindhoven
The Netherlands

UTHealth
The University of Texas
Health Science Center at Houston
Medical School

catharina
ziekenhuis

Disclosure Statement of Financial Interest

Within the past 12+ months, Nils Johnson has had a financial interest/arrangement or affiliation with the organization(s) listed below.

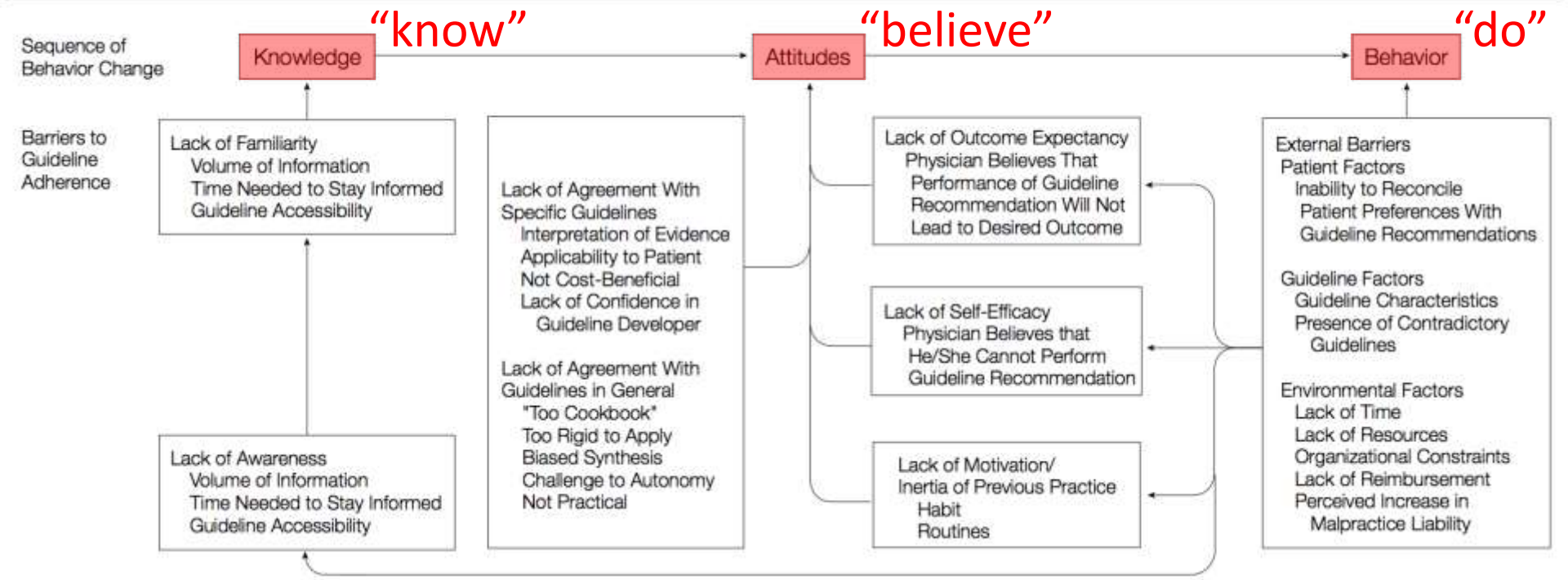
Affiliation/Financial Relationship	Organizations (alphabetical)
• Grant/Research Support (to *institution*)	• St Jude Medical (for CONTRAST study) • Volcano/Philips (for DEFINE-FLOW study)
• Educational organizations (travel support for academic meetings but *never honoraria*)	• ASNC (travel award 2007) • Canadian CPI (Montréal 2013-15) • CRF (TCT 2012-15, CPIIS 2014) • Emory (EPIC-SEC 2015) • ESC (ETP physiology courses 2013-15) • KSIC (annual meeting & IPOP 2015) • PCR (EuroPCR 2015) • SCAI (travel award 2010)

Nils Johnson has *never* personally received *any* money from *any* commercial company. Specifically, he does *not accept* commercial consulting, travel, entertainment, or speaking compensation *of any kind*.

Why Don't Physicians Follow Clinical Practice Guidelines?

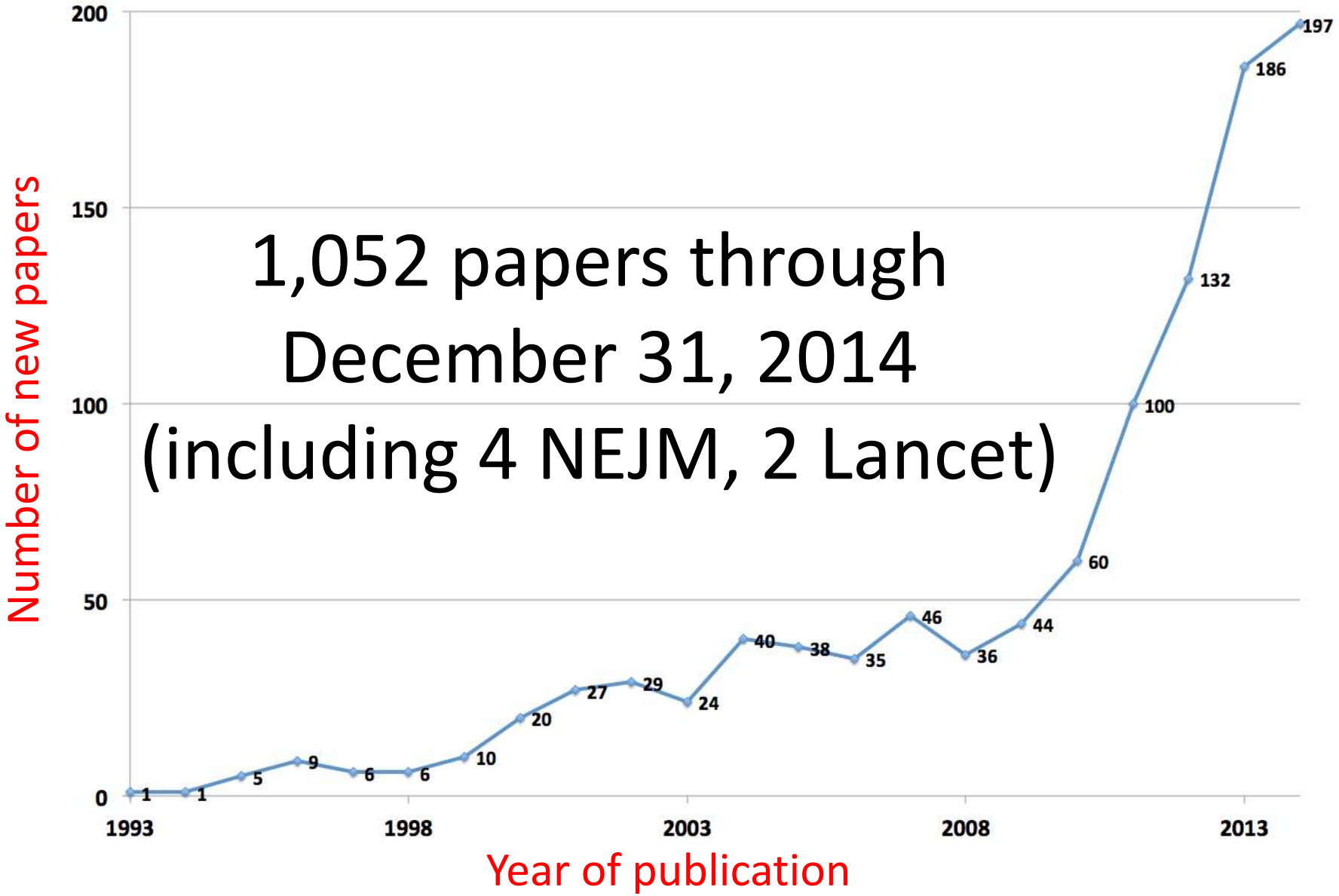
A Framework for Improvement

Figure. Barriers to Physician Adherence to Practice Guidelines in Relation to Behavior Change



Cabana MD, *JAMA*. 1999 Oct 20;282(15):1458-65.

Knowledge: FFR awareness



PubMed search for “FFR” or “fractional flow reserve” (updated January 28, 2015)

How to measure FFR familiarity?

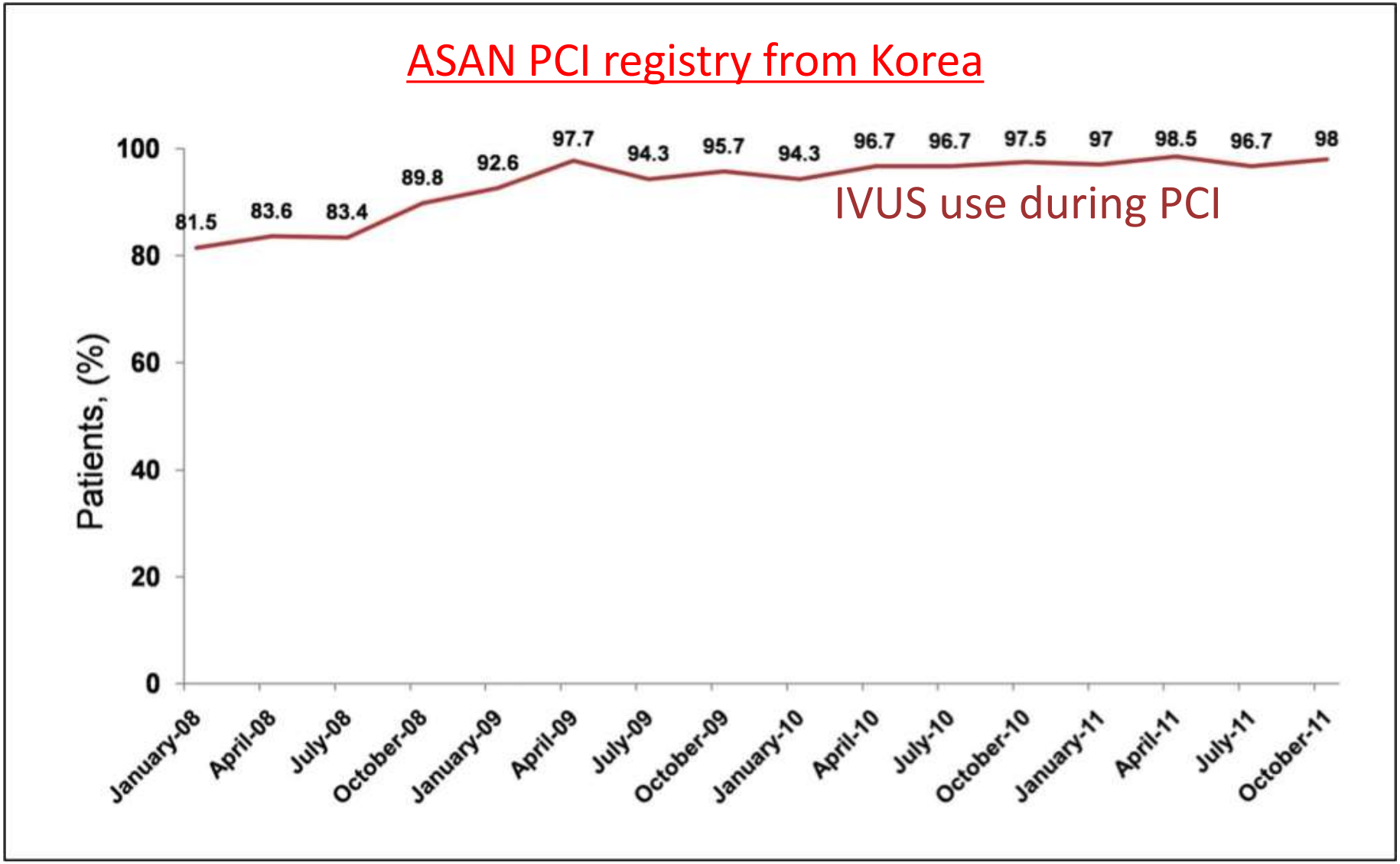
- # of FFR procedures divided by # of PCI procedures
- Advantages
  - Easy to measure
  - Easy to understand
  - Hard to manipulate
- Disadvantages
  - Neglects PCI deferral when FFR high
  - FFR can lead to CABG too
  - Some PCI does not need FFR (like STEMI culprits)

Knowledge: FFR familiarity

	2012	2013	2014	*(2015)*
		USA		
FFR/PCI*	16%	19%	22%	*(25%)*
		Europe		
FFR/PCI	7%	8%	10%	*(12%)*
		Japan		
FFR/PCI	7%	8%	9%	*(10%)*

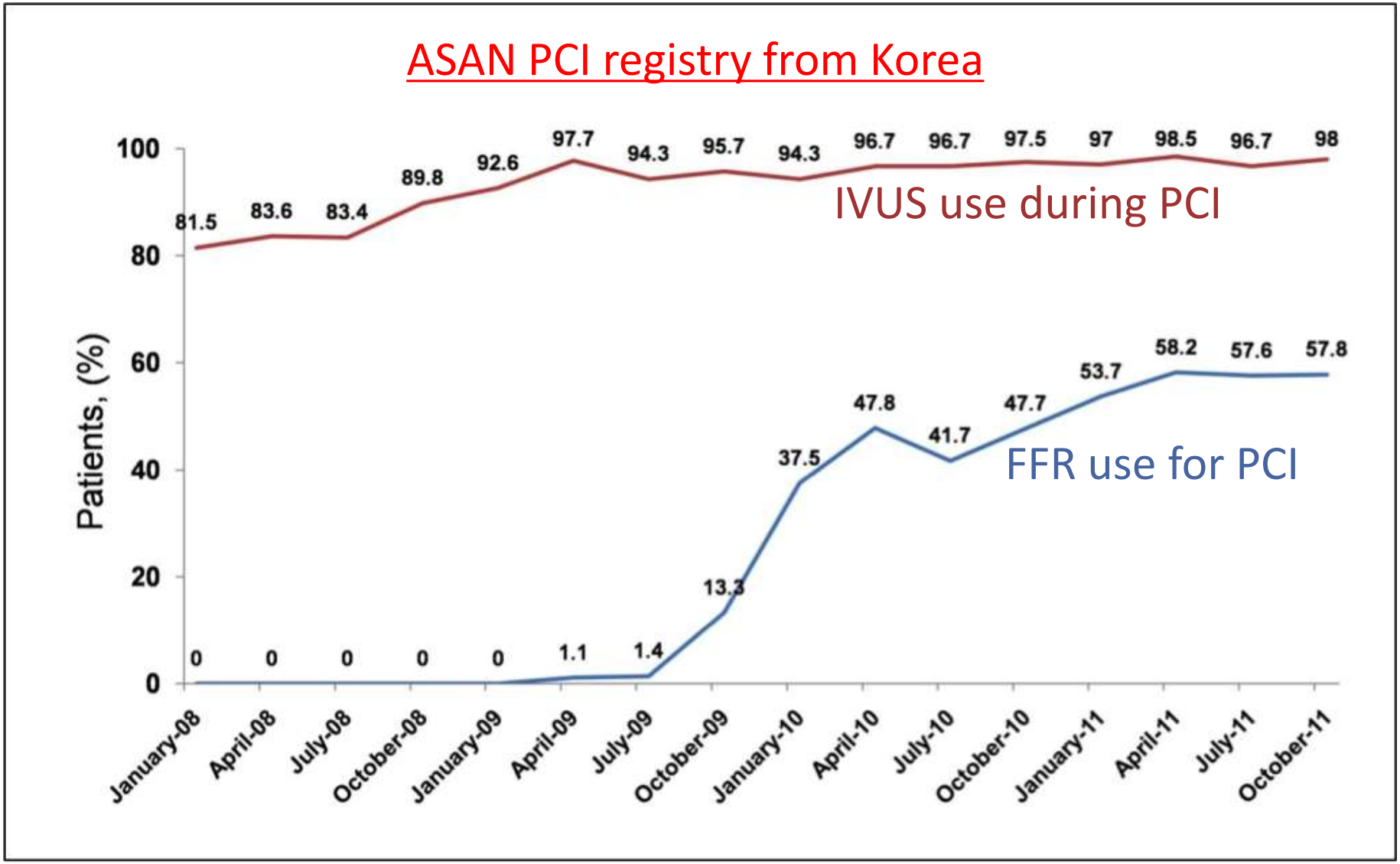
* = public *estimates* from Millennium Research Group (MRG)

FFR familiarity in Korea



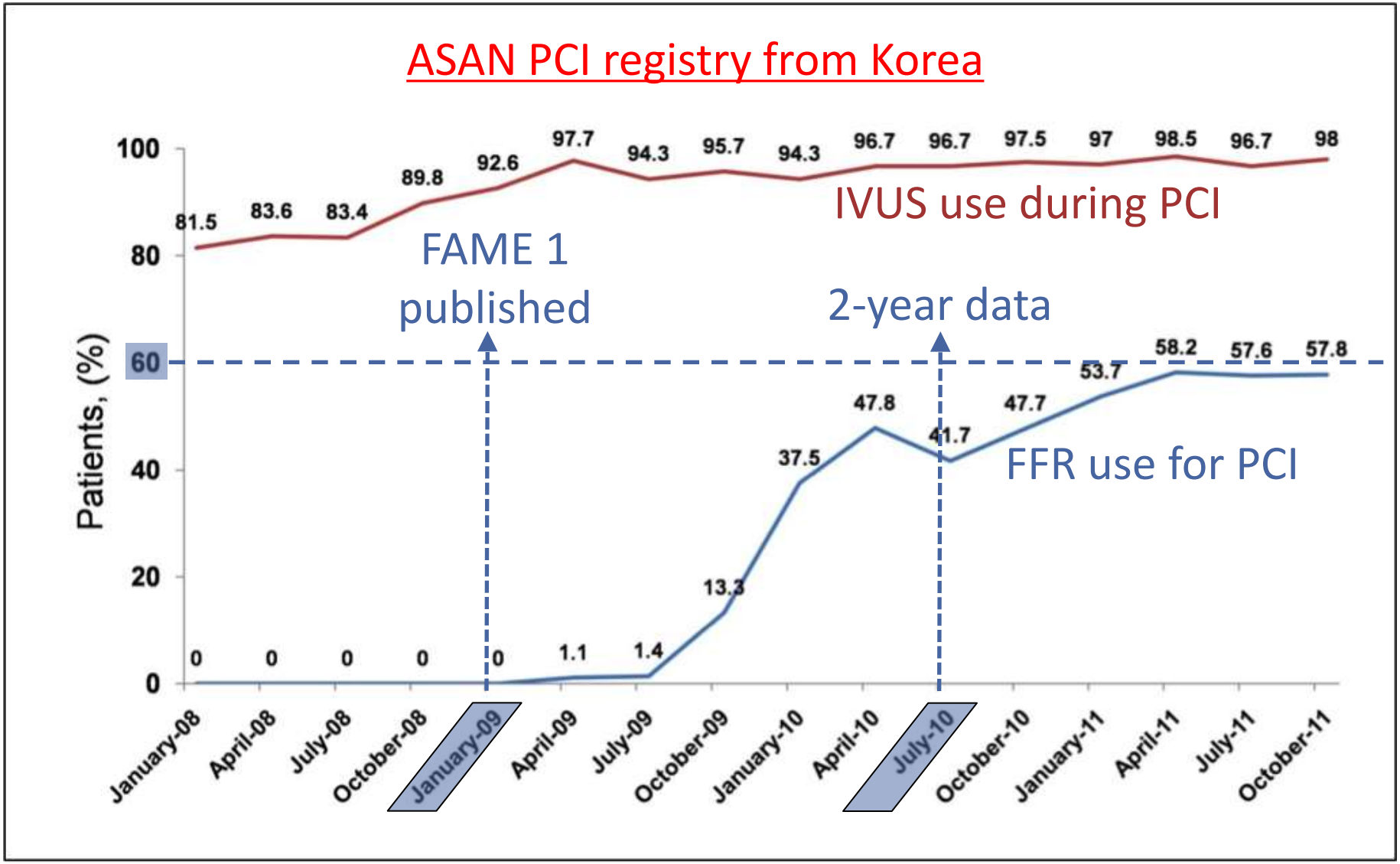
Park SJ, *EHJ*. 2013 Nov;34(43):3353-61. (modified Supplement Figure 1 with my annotations)

FFR familiarity in Korea



Park SJ, *EHJ*. 2013 Nov;34(43):3353-61. (Supplement Figure 1 with my annotations)

FFR familiarity in Korea



Park SJ, *EHJ*. 2013 Nov;34(43):3353-61. (Supplement Figure 1 with my annotations)

Knowledge of FFR: summary

- More than *1,000 papers* on FFR in last 20 years (100-200 new papers per year recently)
- Approximately ½ million FFR in 2015* (roughly *1 FFR per minute* every hour, every day)
- Enormous increase in FFR uptake in last 5 years
- Highest uptake approximately *60% FFR/PCI*
- Variations seen *between* and *within countries*
- Similar patterns exist for *medical therapy*

* = Based on industry *estimates* combined with public *estimates* from Millennium Research Group (MRG)

Will or *should FFR uptake* reach *100%*?

- Stable patients
- NSTEMI (or unstable angina)
  - Culprit
  - Uncertain or non-culprit
- STEMI
  - Culprit
  - Non-culprit
- Unusual, rare (bridging, fistula, anomaly)

Who undergoes PCI these days?

1. stable CAD
   - 30% in USA*
   - 17% in Scandinavia**

   ≈20-30%
2. UA/NSTEMI
   - 55% in USA
   - 48% in Scandinavia

   ≈50%
3. STEMI
   - 16% in USA
   - 33% in Scandinavia

   ≈20-30%

* = NCDR (CathPCI) data from 2010/11 (Dehmer GJ, *JACC*. 2012;60:2017)
** = SCAAR data from 2009/10 (Fokkema ML, *JACC*. 2013;61:1222)

Where is FFR in clinical guidelines?

1. stable CAD
   - ACC/AHA: class IIa/A
   - ESC: class I/A

   ≈20-30%

2. UA/NSTEMI
   - ACC/AHA: 0 words
   - ESC: 2 sentences

   ≈50%

3. STEMI
   - ACC/AHA: 1 study
   - ESC: 13 words

   ≈20-30%

Will or *should FFR uptake* reach *100%*?

- Stable patients
- UA/NSTEMI
  - Culprit
  - Uncertain or non-culprit
- STEMI
  - Culprit
  - Non-culprit

- 25% PCI * 80% FFR
- 50% PCI
  - * 0% FFR
  - 50% * 0% - 100% FFR
- 25% PCI
  - * 0% FFR
  - 50% * 0% - 100% FFR

Lower bound = ¼*80% + ½*½*0% + ¼*½*0% = 20%

Upper bound = ¼*80% + ½*½*100% + ¼*½*100% = 58%

Will or *should FFR uptake* reach *100%*?

- Acute coronary syndromes are 75% of PCI volume
- Yet guidelines for ACS do not advocate FFR

  (despite FAME ACS substudy, FAMOUS, PRIMULTI)
- Thus 20% FFR/PCI matches current guidelines
  - Europe at 12%
  - USA at 25%
  - Scandinavia at 33%
- But likely FFR/PCI uptake will not exceed 60%
  - Assumes 100% use for non-culprits in ACS
  - Debate and ongoing trials for these lesions

Attitudes toward FFR

Current Use of Fractional Flow Reserve:

A Nationwide Survey

- Members of SCAI in USA
- 255 (25%) responses
- February and March 2012

Hannawi B, *Tex Heart Inst J*. 2014 Dec 1;41(6):579-84.

Attitudes toward FFR

If you do not use FFR, why not?		
Not available at our institution	*30*	*(46.9)*
Not ACC/AHA class I recommended	*2*	*(3.1)*
More risk to patient than reward	*3*	*(4.7)*
Takes too much time to set up and perform the test	*16*	*(25)*
Reimbursement issues	*25*	*(39.1)*
I do not understand enough about FFR	*1*	*(1.6)*
I do not trust FFR	*3*	*(4.7)*
Skipped question	*191*	

"know" (knowledge) barrier

<2% (minor)

Hannawi B, *Tex Heart Inst J*. 2014 Dec 1;41(6):579-84.

Attitudes toward FFR

If you do not use FFR, why not?		
Not available at our institution	30	(46.9)
Not ACC/AHA class I recommended	2	(3.1)
More risk to patient than reward	3	(4.7)
Takes too much time to set up and perform the test	16	(25)
Reimbursement issues	25	(39.1)
I do not understand enough about FFR	1	(1.6)
I do not trust FFR	3	(4.7)
Skipped question	191	

"belief" (attitude) barriers

5% (minor)

Hannawi B, *Tex Heart Inst J*. 2014 Dec 1;41(6):579-84.

Attitudes toward FFR

If you do not use FFR, why not?

Not available at our institution	*30*	*(46.9)*
Not ACC/AHA class I recommended	*2*	*(3.1)*
More risk to patient than reward	*3*	*(4.7)*
Takes too much time to set up and perform the test	*16*	*(25)*
Reimbursement issues	*25*	*(39.1)*
I do not understand enough about FFR	*1*	*(1.6)*
I do not trust FFR	*3*	*(4.7)*
Skipped question	*191*	

"do" (environment) barriers MAJOR

Hannawi B, *Tex Heart Inst J*. 2014 Dec 1;41(6):579-84.

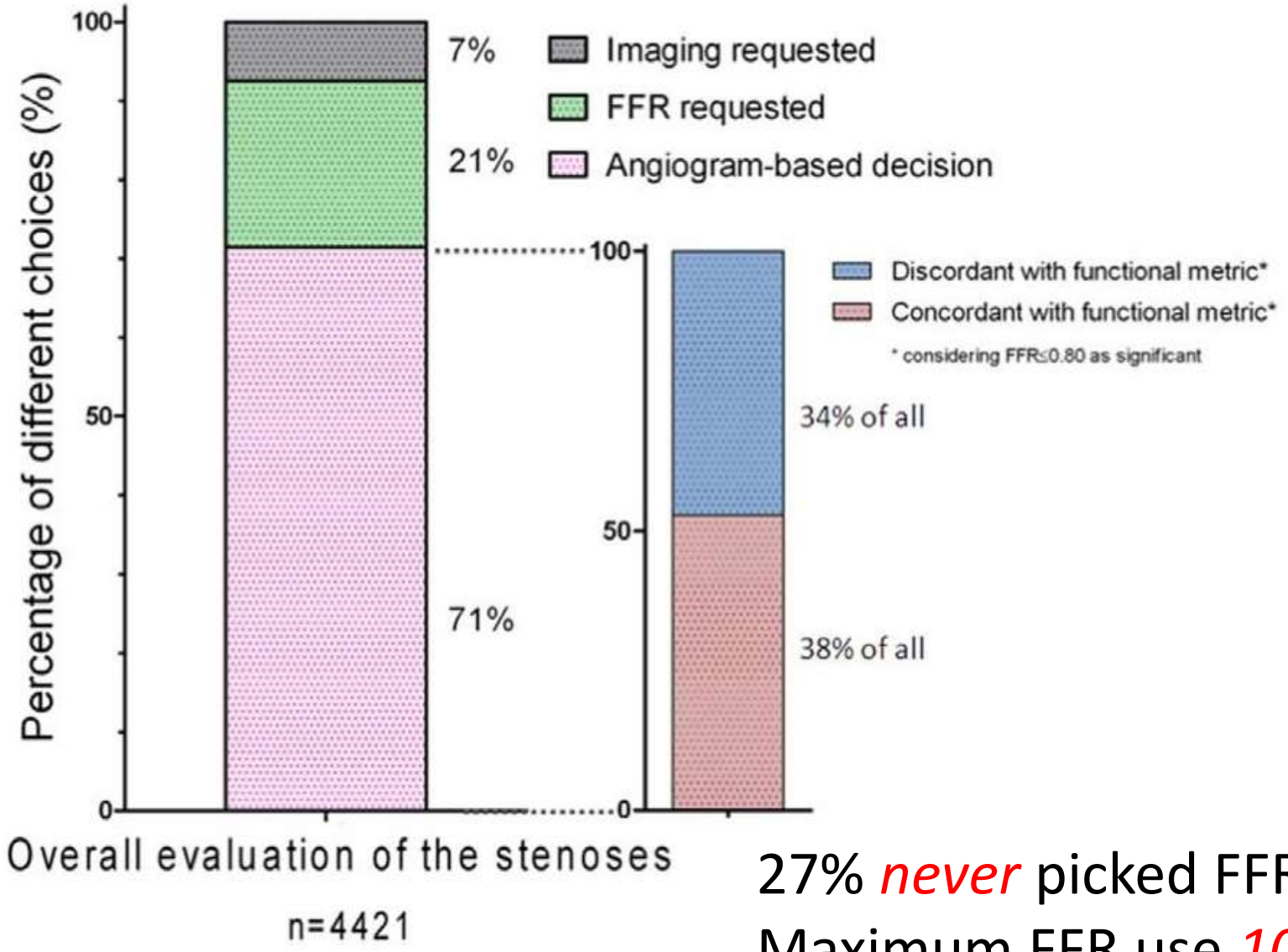
Attitudes toward FFR

"Participants were asked to make their decisions assuming *ideal world conditions*, *without considering any financial restrictions* or local regulations, but only after the best clinical practice achievable in this virtual catheterization laboratory."

5 stable patients with 12 lesions
QCA 32% to 72%
495 responses via PCRonline

Toth GG, *Circ Cardiovasc Interv*. 2014 Dec;7(6):751-9. (Figure 1)

Attitudes toward FFR



27% *never* picked FFR

Maximum FFR use *10/12*

Toth GG, *Circ Cardiovasc Interv*. 2014 Dec;7(6):751-9. (Figure 4)

Changing FFR behavior: *legal*

40. The nurses, technicians, and staff in the cardiac catheterization lab at Saint Joseph-London worked directly with Defendant Drs. Patil, Chalhoub, and Chatterjee and knew or should have known what they were doing, participated in the unnecessary and non-indicated procedures, and failed to prevent or report their actions.

f. failed to confirm or properly quantify the significance of using well-accepted intra-procedural techniques, such as fractional flow reserve or intravascular ultrasound;

Slide courtesy of Joe Burnett from Volcano

Changing FFR behavior: *audits*

CMS.gov
Centers for Medicare & Medicaid Services

PTA is covered when used [for] … Treatment of Atherosclerotic Obstructive Lesions … of a single coronary artery for patients for whom the likely alternative treatment is coronary bypass surgery and who exhibit the following characteristics:

- Angina refractory to optimal medical management;
- ***Objective evidence of myocardial ischemia***; and
- Lesions amenable to angioplasty.

Recovery Audit Program

Mission - The Recovery Audit Program's mission is to identify and correct Medicare improper payments through the efficient detection and collection of overpayments made on claims of health care services provided to Medicare beneficiaries, and the identification of underpayments to providers so that the CMS can implement actions that will prevent future improper payments in all 50 states.

http://www.cms.gov/medicare-coverage-database/details/ncd-details.aspx?NCDId=201&ncdver=9&bc=BAABAAAAAAAA, Accessed June 9, 2014 (my ***emphasis*** added)
http://www.cms.gov/Research-Statistics-Data-and-Systems/Monitoring-Programs/Medicare-FFS-Compliance-Programs/Recovery-Audit-Program/, Accessed June 9, 2014 (my highlight)

Changing FFR behavior: *incentives*

CZ geeft Catharina Ziekenhuis Eindhoven meer geld bij betere zorg

26 november 2015 | Laatste update: 26 november, 09:23 1 REAGEER (6)

Het Catharina Ziekenhuis in Eindhoven. ©Menno Boon

"CZ [large Dutch health care insurance company] will give the Catharina Hospital in Eindhoven more money for better care"

➔ outcome-based payments (*FFR leads to better outcomes*)

http://www.ed.nl/regio/eindhoven/cz-geeft-catharina-ziekenhuis-eindhoven-meer-geld-bij-betere-zorg-1.5479592 (accessed December 2, 2015)

Changing FFR behavior: *AUC, registry*

JACC Vol. 59, No. 22, 2012
May 29, 2012:1995–2027

Table 1.4. Adjunctive Invasive Diagnostic Testing in Patients Undergoing Appropriate Diagnostic Coronary Angiography

Indication		Appropriate Use Score (1–9)		
		Unexpected Angiographic Finding or No Prior Noninvasive Testing	Prior Testing = No Ischemic Findings	Prior Testing = Concordant* Ischemic Findings
FFR for Lesion Severity				
40.	• Angiographically indeterminate severity left main stenosis (defined as 2 or more orthogonal views contradictory whether stenosis >50%)	A (7)	A (7)	A (7)
41.	• Nonobstructive disease by angiography (non-left main) <50%	I (3)	I (2)	U (5)
42.	• Angiographically intermediate disease (non-left main) 50% to 69%	A (7)	U (6)	A (7)
43.	• Angiographically obstructive significant disease (non-left main) ≥70% stenosis	A (7)	A (7)	I (3)

CathPCI Registry

NCDR® CathPCI Registry® v4.4
Diagnostic Catheterization and Percutaneous Coronary Intervention Registry

H. LESIONS AND DEVICES (COMPLETE FOR EACH PCI ATTEMPTED OR PERFORMED)

Lesion Counter[7100]:	1	2
Segment Number(s)[7105]:	_____, _____, _____, _____, _____	_____, _____, _____, _____, _____
If CAD Presentation[5000] is 'STEMI', 'Non-STEMI', or 'Unstable angina', **Culprit Lesion**[7110]:	O No O Yes O Unknown	O No O Yes O Unknown
Stenosis Immediately Prior to Rx[7115]:	_____%	_____%
→ **If** 100%, **Chronic Total Occlusion**[7120]:	O No O Yes	O No O Yes
→ **If** 40-70%, **IVUS**[7125]:	O No O Yes	O No O Yes
→ **If** 40-70%, **FFR**[7130]:	O No O Yes	O No O Yes
→ **If Yes, FFR Ratio**[7135]:	_____	_____

How to use the *right amount* of FFR

- Knowledge ("know")
  - Largest gap for acute coronary syndromes
  - Likely maximum 60% FFR/PCI in future
- Attitudes ("believe")
  - Move beyond the angiogram
- Behavior ("do")
  - Media and legal
  - Payments (audits *and* incentives)
  - Appropriate use criteria and registry