Coronary psychology

Why don't we use physiology more often?

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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)
• Licensing and associated consulting (to *institution*)	• Boston Scientific (for smart-minimum FFR algorithm)
• Support for educational meetings/training (honoraria/fees donated to *institution*)	• Various, including academic and industry
• PET software 510(k) from FDA (application by Lance Gould, to *institution*)	• K113754 (cfrQuant, 2011) • K143664 (HeartSee, 2014) • K171303 (HeartSee update, 2017)
• Patent pending (USPTO serial number 62/597,134)	• SAVI and ΔP/Q methods

EDITORIAL COMMENT

Coronary Psychology

Do You Believe?*

Nils P. Johnson, MD, MS,[a] Bon-Kwon Koo, MD, PhD[b]

Johnson NP and Koo BK. *JACC Cardiovasc Interv*. 2018 Aug 13;11(15):1492-1494.

Why Don't Physicians Follow Clinical Practice Guidelines?

A Framework for Improvement

Conclusions Studies on improving physician guideline adherence may not be generalizable, since barriers in one setting may not be present in another. Our review offers a differential diagnosis for why physicians do not follow practice guidelines, as well as a rational approach toward improving guideline adherence and a framework for future research.

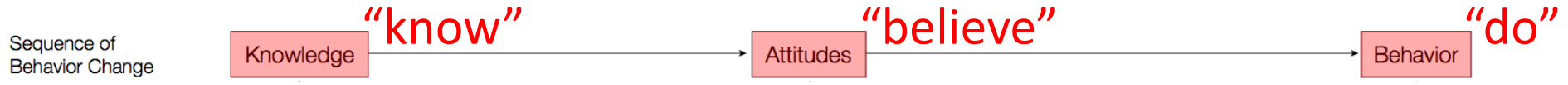
JAMA. 1999;282:1458-1465 www.jama.com

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

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



Barriers to Guideline Adherence

- *Knowledge*
  - Lack of awareness or familiarity
- *Attitudes*
  - Lack of agreement with guidelines
  - Too rigid, too "cookbook"
  - Inertia of previous practice
  - Not practical or cost-beneficial
- *Behavior*
  - Guidelines
  - Environment (time, money)
  - Patient preferences

Cabana MD, *JAMA*. 1999 Oct 20;282(15):1458-65. (Title, upper portion of figure, text based on lower portion of figure)

Physiology survey #1

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.

Physiology survey #1

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*	

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

Physiology survey #1

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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.

Physiology survey #1

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	

"attitude" (belief) barriers

5% (minor)

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

Physiology survey #1

If you do not use FFR, why not?

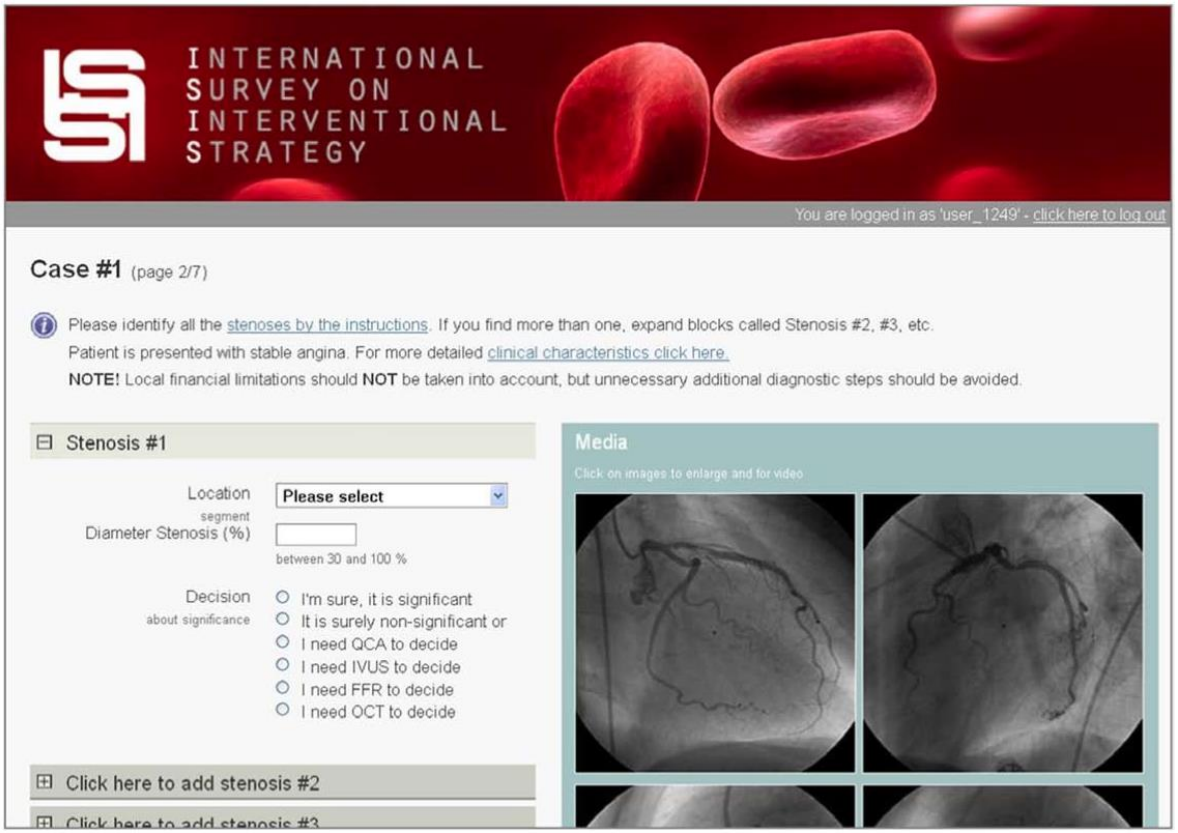
Not available at our institution	*30*	*(46.9)*
Not ACC/AHA class I recommended	*2*	*(3.1)*
More risk to patient than reward	*3*	*(4.7)*
Takes too much time to set up and perform the test	*16*	*(25)*
Reimbursement issues	*25*	*(39.1)*
I do not understand enough about FFR	*1*	*(1.6)*
I do not trust FFR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

"environment" (do) barriers

MAJOR

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

Physiology survey #2

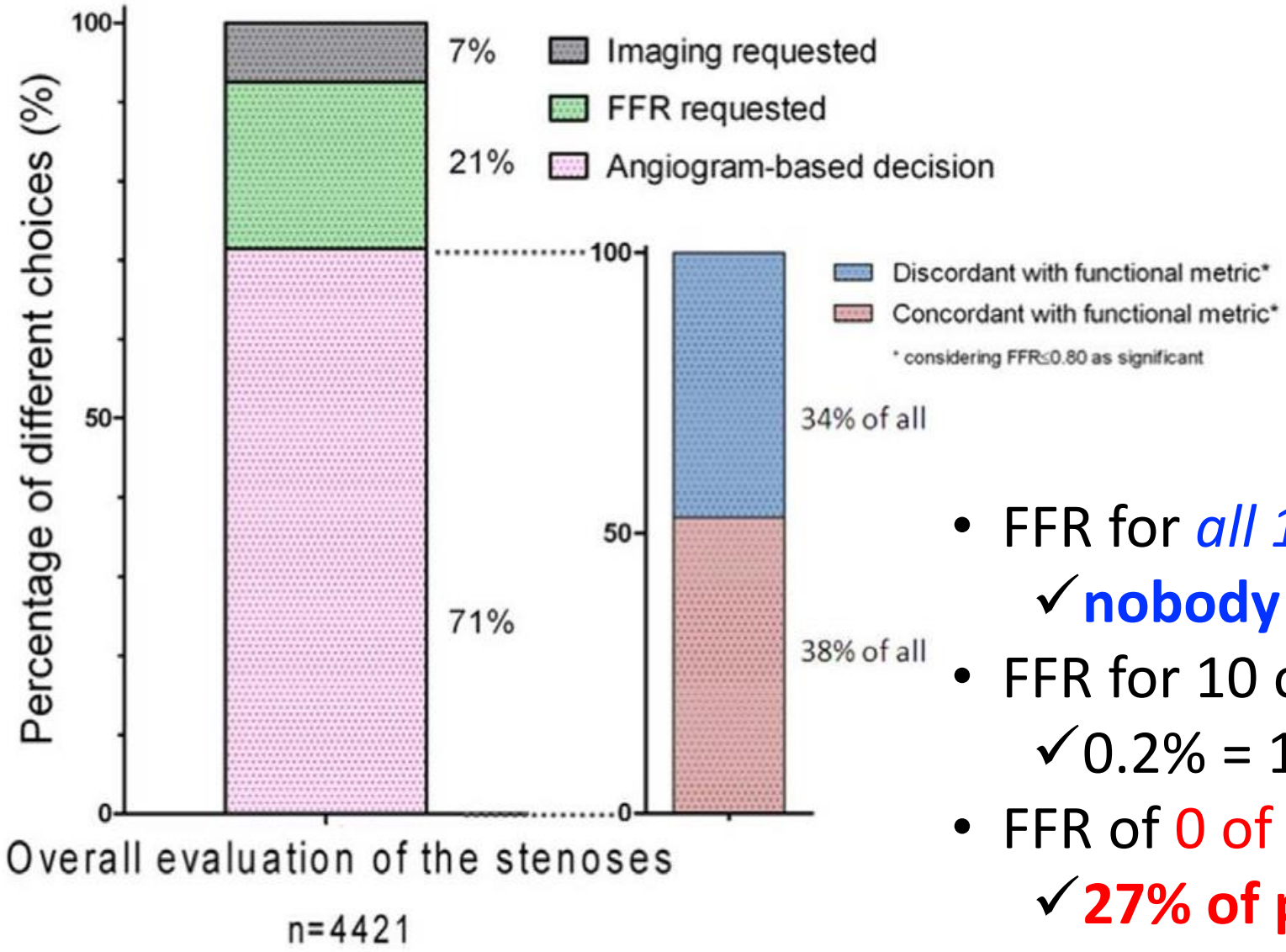


"Participants were asked to make their decisions assuming *ideal world conditions*, *without considering any financial restrictions* or local regulations, but only after the best clinical practice achievable in this virtual catheterization laboratory."

5 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)

Physiology survey #2



- FFR for *all 12 cases*
  - ✓**nobody**
- FFR for 10 of 12 cases
  - ✓0.2% = 1 participant
- FFR of 0 of 12 cases
  - ✓**27% of participants**

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

Physiology survey #3

Evolving Routine Standards in Invasive Hemodynamic Assessment of Coronary Stenosis

The Nationwide Italian SICI-GISE Cross-Sectional ERIS Study

- 76 cath labs in Italy, *at least 20 FFR/iFR per year*
- *60-day period to monitor all eligible FFR/iFR cases*
- 1858 cases included (7% of CAG and 13% of PCI volume)
- *3 prespecified clinical scenarios*
  - ✓stable lesion, 50-90%DS, equivocal or missing stress test
  - ✓stable lesion, 50-70%DS, stress test available
  - ✓non-culprit lesion in NSTEMI presentation

Tebaldi M, *JACC Cardiovasc Interv*. 2018 Aug 13;11(15):1482-1491.

Attitude >> External barriers

TABLE 2 Operator Rationale for Not Performing a Physiology Assessment When Indicated

Attitudes (lack of agreement and inertia of previous practice)	
Clinical and angiographic data are sufficient	455 (39.3)
Certainly significant lesion	223
Certainly not significant lesion	164
FFR/iFR does not improve my ability to stratify lesions	68
I prefer to achieve a complete revascularization	102 (8.8)
Co-culprit lesion in a patient with ACS	67 (5.7)
I will monitor the patient's symptoms during follow-up	56 (4.5)
Knowledge (lack of awareness and familiarity)	
FFR/iFR not feasible (e.g., wire does not cross the lesion and myocardial bridge)	129 (11.1)
Lesion >50% in the proximal LAD or left main coronary artery	120 (10.3)
Intracoronary imaging (IVUS/OCT) is better	82 (7.5)
Stratification in the follow-up with stress test	40 (3.4)
Behavior (external barriers)	
Time constraint	47 (4.1)
Adenosine side effects or cost	30 (2.6)
Costs	28 (2.5)

Tebaldi M, *JACC Cardiovasc Interv*. 2018 Aug 13;11(15):1482-1491. (Table 2)

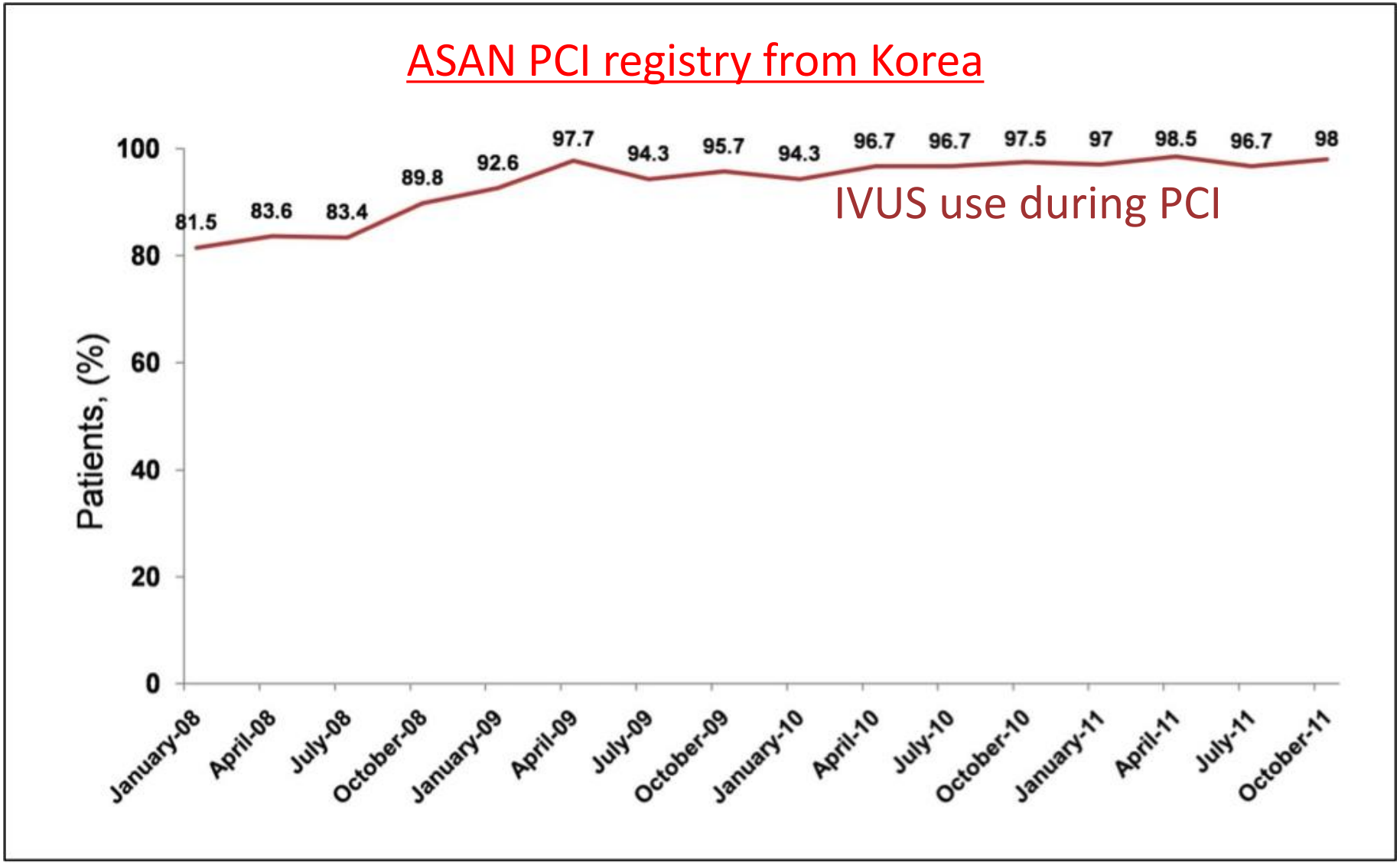
1858 cases included

- 1177 physiology (63%)
- 681 angiogram (37%)

How to measure behavior?

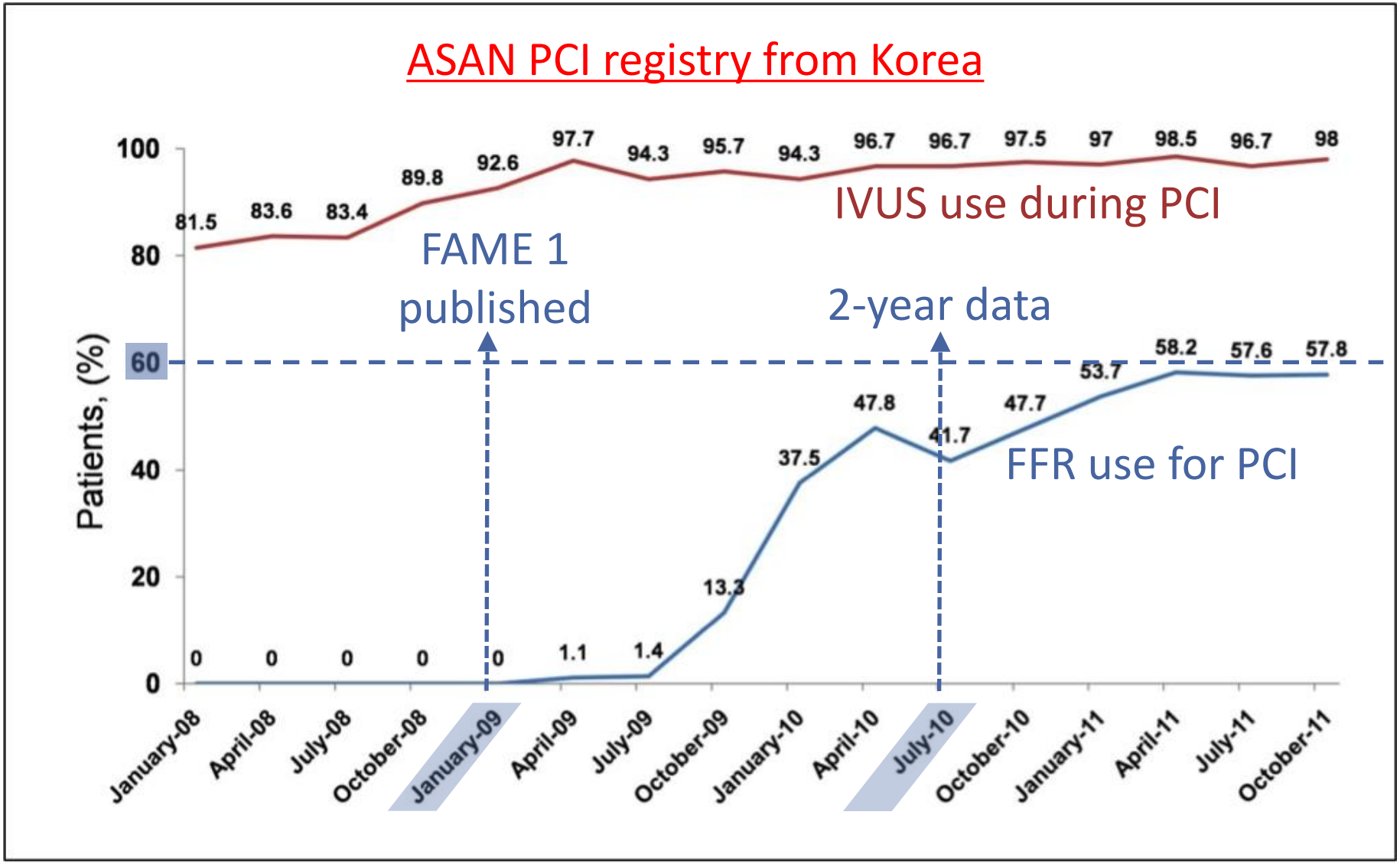
- # of pressure wires divided by # of PCI procedures
- Advantages
  - Easy to measure
  - Easy to understand
  - Hard to manipulate
- Disadvantages
  - Neglects PCI deferral when physiology high
  - Physiology can lead to CABG too
  - Some PCI does not need physiology (like STEMI culprits)

Behavior: *Korea*



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

Behavior: *Korea*



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

Behavior: *USA*

Original Investigation

Appropriate Use Criteria for Coronary Revascularization and Trends in Utilization, Patient Selection, and Appropriateness of Percutaneous Coronary Intervention

Table 2. Baseline Characteristics of Patients Undergoing Nonacute Percutaneous Coronary Intervention (PCI) From July 1, 2009–December 31, 2014

	No. (%)						
Patient Characteristics	Total	2009[a]	2010	2011	2012	2013	2014
No.	397 737 (100.0)	41 024 (10.3)	89 704 (22.6)	78 328 (19.7)	66 849 (16.8)	62 457 (15.7)	59 375 (14.9)
Fractional flow reserve among patients with 40%-70% lesions	14 636 (18.0)	706 (8.1)	1987 (10.2)	2285 (13.8)	2824 (21.6)	3369 (28.2)	3465 (30.8)

- PW/PCI use increased by *3.8-fold in 5 years*
  - 2009 = 8.1%
  - 2010 = 10.2%
  - 2011 = 13.8%
  - 2012 = 21.6%
  - 2013 = 28.2%
  - 2014 = 30.8%
- PCI declined by 1/3 over same period

Desai NR, *JAMA*. 2015 Nov 7;314(19):2045-53. (Table 2, portion on FFR)

Behavior: *Europe*

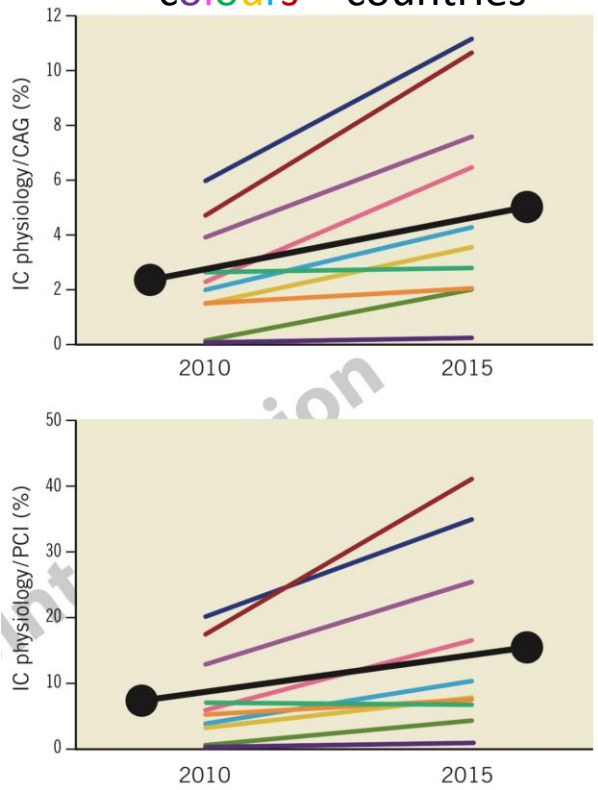
Current trends in coronary interventions: an overview from the EAPCI registries

Emanuele Barbato[1,2]*, MD, PhD; Dariusz Dudek[3], MD, PhD, FESC; Andreas Baumbach[4], MD, FESC; Stephan Windecker[5], MD, PhD, FESC; Michael Haude[6], MD, FESC

Table 1. Overall trend in interventional cardiology practice.

	2010	2015
CAG, n	1,574,503	1,793,487
PCI, n	707,676	889,957
Transradial procedures, %	45 (29-57)	67 (51-80)
PCI × operator, n	124 (101-142)	136 (110-171)
Complex PCI, %	6 (3-9)	7 (4-11)
IC imaging/CAG, %	1.3 (0.1-2.8)	1.1 (0.4-3.2)
IC imaging/PCI, %	3.1 (0.3-5.7)	2.6 (0.9-7.3)

colours = countries



"*despite the lack of reimbursement in many countries, the **use of intracoronary physiology techniques doubled from 2010 to 2015***, though it still remained lower than 6% and 20% of the total volume of coronary angiography and of PCI, respectively"

Barbato E, *EuroIntervention*. 2017 May 15;13(Z):Z8-Z10. (Table 1 [upper part], Figure 3, and quote with *my **emphasis***)

Changing behavior: *public registry*

Anno	Regione	Provincia	Città	Centro	Responsabile	5.12 % PCI con approccio retrogrado	5.13 Tronco comune non protetto	5.14 PCI con solo stent BMS	5.15 PCI con almeno un DES	5.16 PCI con almeno un BRS	5.17 N° PCI con DEB	5.18 N° stent BMS	5.19 N° stent DES	5.20 N° scaffold BRS	5.21 Rapporto N° stent totali impiantati per PCI (stent DES + stent BMS + scaffold BRS ÷ N° totale angioplastiche coronariche)	5.22 N° procedure con cateteri laser	5.23 N° procedure con cateteri Rotablator	5.24 N° procedure con sistemi di aspirazione del trombo	5.25 N° procedure con IVUS	5.26 N° procedure con OCT	5.27 N° procedure con FFR
2016	Liguria	SV	PIETRA LIGURE	OSPEDALE SANTA CORONA	NICOLINO ANNAMARIA	0	37	2	465	0	11	2	650	0	1,4	0	11	26	48	18	61
2016	Liguria	SV	SAVONA	OSPEDALE SAN PAOLO - ASL 2 SAVONESE	BELLONE PIETRO	1	14	15	439	4	32	15	589	4	1,3	0	4	30	10	11	42
Liguria						**3**	**154**	**172**	**3554**	**122**	**124**	**193**	**4252**	**187**	**11,1**	**7**	**51**	**492**	**163**	**60**	**509**
LOMBARDIA																					
2016	Lombardia	MI	MILANO	OSPEDALE UNIVERSITARIO SAN RAFFAELE	COLOMBO ANTONIO	18	99	10	1123	71	97	11	2135	126	1,8	7	34	32	151	56	178

In 2016 Colombo's lab at San Raffaele (Milan)

- 207 IVUS/OCT procedures
- 178 FFR procedures
- (97+11+2135+126) = 2369 PCI
- *178/2369 = 7.5%*
- Italian average = 5% that year

SICI-GISE, *Cardiologia Invasiva*. 2017;14. (Portions of table on page 45)

Changing behavior: ¥

Considering the importance of discriminating the lesions most likely to derive clinical benefit from PCIs, the Japanese Central Social Insurance Medical Council has changed the requirement for the reimbursement of PCIs in April 2018.

Following this change, the role of physiological lesion assessment in catheter laboratories is expected to increase considering the low penetration rate of the non-invasive physiological test in Japan.

Kawase Y, *Cardiovasc Interv Ther*. 2019 Jan;34(1):85-96. (Excerpt from introduction with *highlights*)

Behavior: *summary*

TABLE 1 Public Reporting of Coronary Physiology Uptake

Country (Ref. #)	Year	PW	PCI	PW/PCI	Temporal Change	Hospital-Level Reporting?
Sweden (9)	2017	NR	NR	26%	3.1-fold in 10 yrs	Yes
United Kingdom (10)	2016	18,811	100,483	19%	3.5-fold in 8 yrs	Yes
Italy (11)	2016	11,000	218,751	5%	1.4-fold in 4 yrs	Yes
Europe EAPCI (12)	2015	NR	889,957	16%	2-fold in 5 yrs	Per country
United States (13)	2014	3,465*	NR	31%	3.8-fold in 5 yrs	No
Australia (14)	2015	NR	3,869	19%	100-fold in 9 yrs	Per state

*Limited to a subset of the 59,375 patients in the National Cardiovascular Data Registry CathPCI Registry with lesions deemed 40–70% by visual assessment.

EAPCI = European Association of Percutaneous Cardiovascular Interventions; NR = not reported; PCI = percutaneous coronary intervention; PW = intracoronary pressure wire.

Johnson NP and Koo BK. *JACC Cardiovasc Interv*. 2018 Aug 13;11(15):1492-1494. (Table 1)