

Place de L'IFR

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Conflits d'intérêt

- Rien à déclarer

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Guidelines FFR

TABLE 1 Guideline Recommendations for the Use of FFR

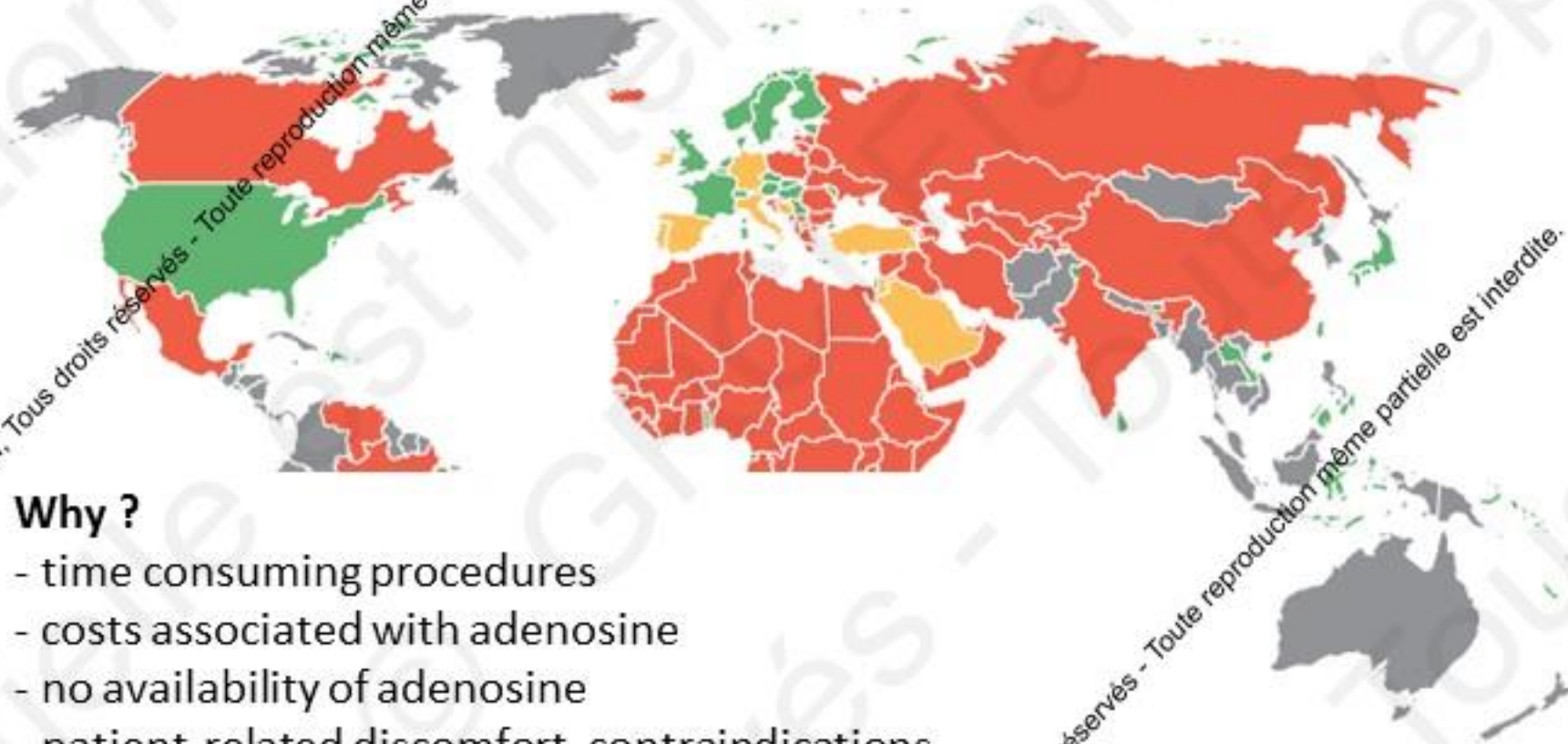
Organization(s)	Guideline Title	Year of Publication	Recommendation	Class	Level of Evidence
European Society of Cardiology and the European Association for Cardio-Thoracic Surgery	Guidelines on myocardial revascularization	2014	FFR to identify hemodynamically relevant coronary lesion(s) in stable patients when evidence of ischemia is not available (1)		A
American College of Cardiology/American Heart Association, American Association for Thoracic Surgery, Preventive Cardiovascular Nurses Association, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons	Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease	2012	For recommendations about revascularization, coronary stenoses with FFR ≤ 0.80 can also be considered to be significant (2)	NA	NA
American Association for Thoracic Surgery, American Heart Association, American Society of Echocardiography, American Society of Nuclear Cardiology, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Computed Tomography, and Society of Thoracic Surgeons	Appropriate Use Criteria for Coronary Revascularization in Patients With Stable Ischemic Heart Disease	2017	If no stress test performed or, if performed, results are indeterminate, FFR ≤ 0.80 can be used to determine appropriateness of revascularization (35)	NA	NA

FFR = fractional flow reserve; NA = not applicable.

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FIGURE 1 Global Adoption of Coronary Physiology to Guide Revascularization Decision Making in 2016



Why ?

- time consuming procedures
- costs associated with adenosine
- no availability of adenosine
- patient-related discomfort, contraindications
- lack of reimbursement

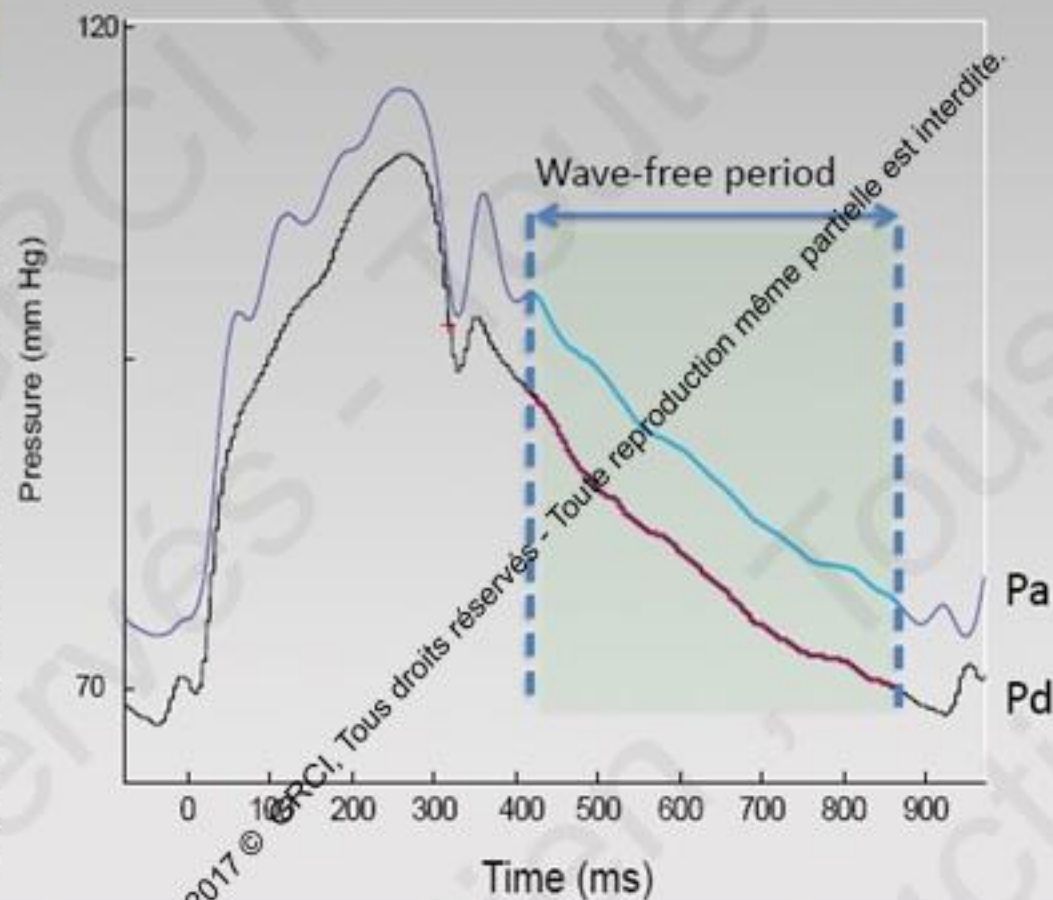
Despite clinical guideline recommendations for its use, the uptake of fractional flow reserve in coronary catheter laboratories worldwide remains low. Reproduced with permission from Philips Volcano, market research report by Decision Resources Group.

iFR = Instantaneous Wave-Free Ratio

$$iFR = \frac{Pd_{\text{wave free period}}}{Pa_{\text{wave free period}}}$$

Definition:

Instantaneous pressure ratio, across a stenosis during the wave-free period, when resistance is naturally constant and minimised in the cardiac cycle

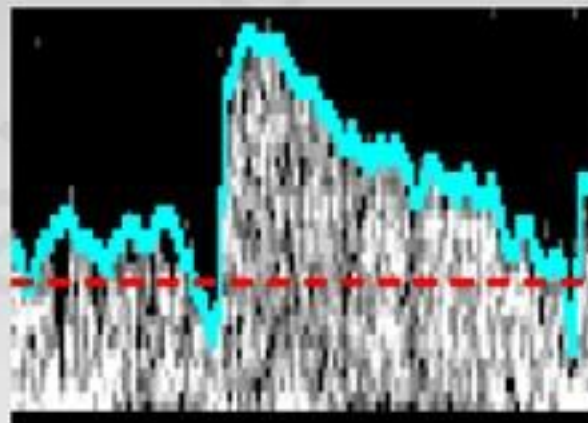


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Resting Gradients – Pd/Pa and iFR

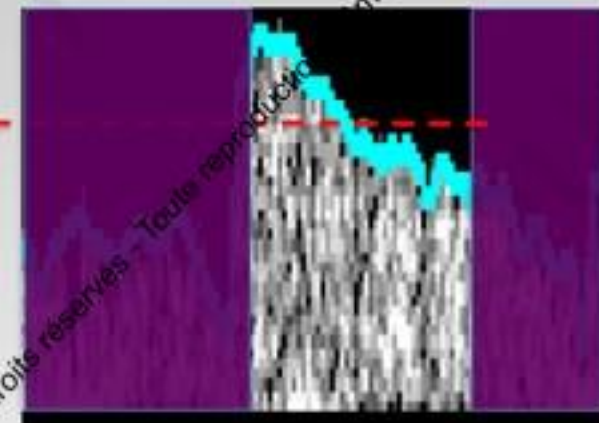
Detect trans-coronary gradients by using physiologically increased flow during diastole

Complete cycle flow



← systole → ← diastole →

Diastolic flow

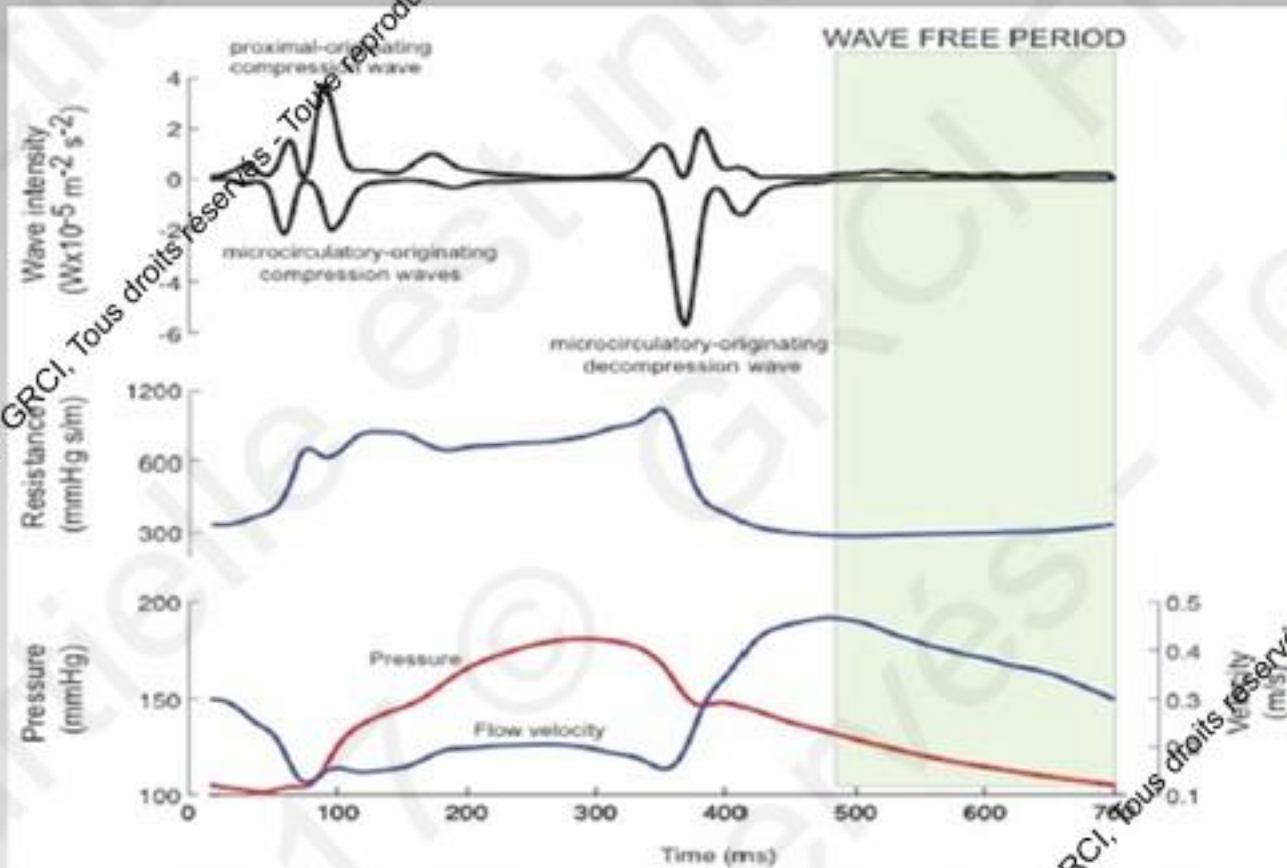


Mean velocities from ADVISE

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Concept of Wave-Free Period



- 1 Noise from compression and suction waves is minimized
- 2 Resistance is constant so ΔP is proportional to ΔQ (flow)
- 3 Velocity is higher so better power to discriminate

Place de l'iFR

- Modèle Hybride iFR/FFR
- Evidence clinique (études randomisées)
- iFR & situations particulières

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Place de l'iFR

- **Modele Hybride iFR/FFR**

- Evidence clinique (études randomisées)

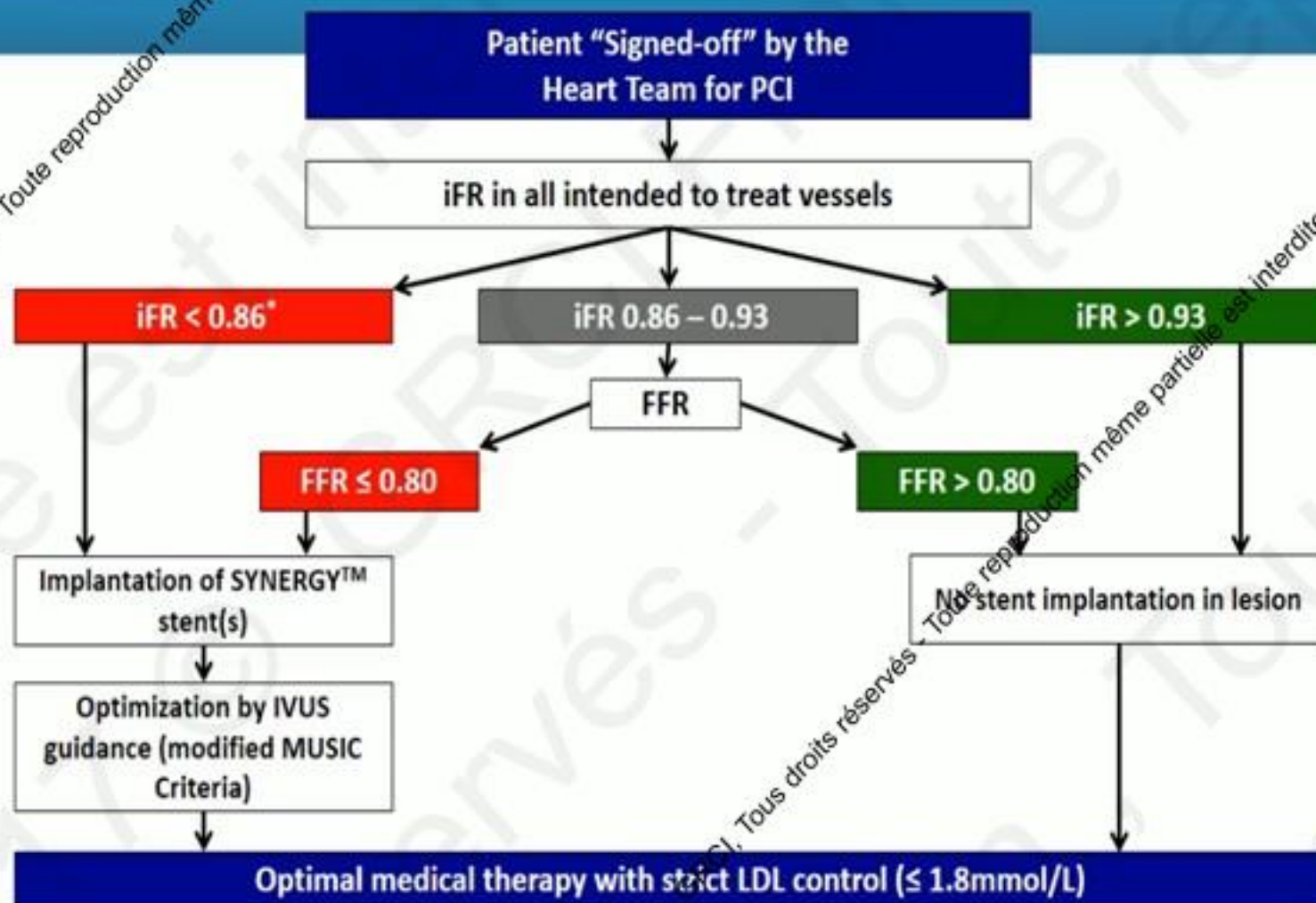
- iFR & situations particulières

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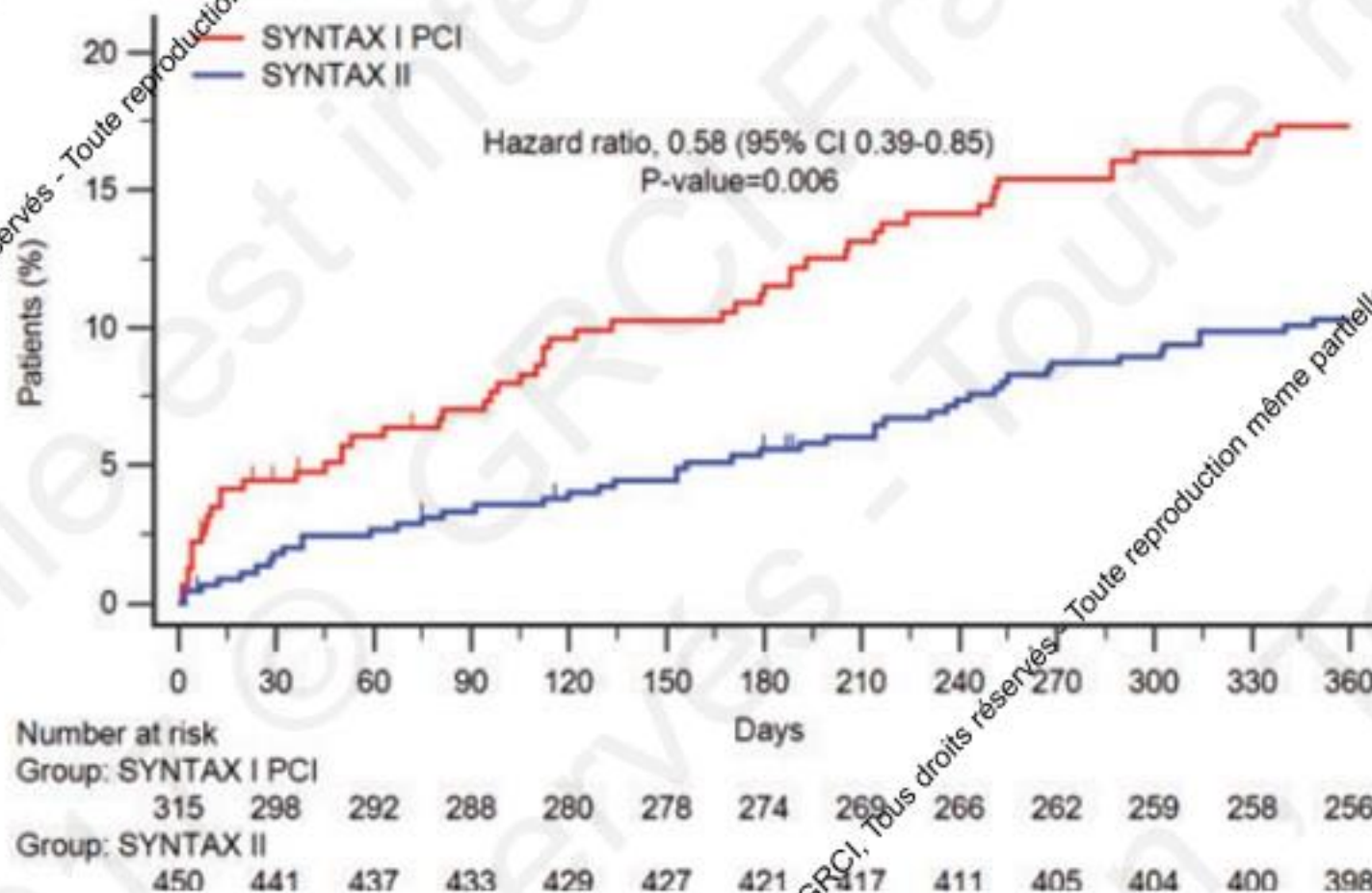
SYNTAX II

PCI Procedure Flowchart





Combining iFR/FFR= gold standard of PCI ?



Place de l'iFR

- Modèle Hybride iFR/FFR
- **Evidence clinique (études randomisées)**
- iFR & situations particulières

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DEFINE FLAIR

ORIGINAL ARTICLE

Use of the Instantaneous Wave-free Ratio or Fractional Flow Reserve in PCI

J.E. Davies, S. Sen, H.-M. Dehbi, R. Al-Lamee, R. Petraco, S.S. Nijjer, R. Bhandi, S.J. Lehman, D. Walters, J. Sapontis, L. Janssens, C.J. Vrints, A. Khashaba, M. Laine, E. Van Belle, F. Krackhardt, W. Bojara, O. Going, T. Härle, C. Jolly, G. Niccoli, F. Ribichini, N. Tanaka, H. Yokoi, H. Takashima, Y. Kikuta, S. Erglis, H. Vinhas, P. Canas Silva, S.B. Baptista, A. Alghamdi, F. Hellig, R. Koo, C.-W. Nam, E.-S. Shin, J.-H. Doh, S. Brugaletta, E. Alegria-Barrero, R. Meuwissen, J.J. Piek, N. van Royen, M. Sezer, C. Di Mario, R.T. Gerber, S. Malik, A.S.P. Sharp, S. Talwar, K. Tang, H. Samady, J. Altman, A. Seto, J. Singh, A. Jeremias, H. Matsuo, R.K. Kharbanda, M.R. Patel, P. Serruys, and J. Escaned

ORIGINAL ARTICLE

Instantaneous Wave-free Ratio versus Fractional Flow Reserve to Guide PCI

M. Götberg, E.H. Christiansen, I.J. Gudmundsdottir, L. Sandhall, M. Danielewicz, L. Jakobsen, S.-E. Olsson, P. Öhagen, H. Olsson, E. Omerovic, F. Calais, P. Lindroos, M. Maeng, T. Tödt, D. Venetsanos, S.K. James, A. Käregren, M. Nilsson, J. Carlsson, D. Hauer, J. Jensen, A.-C. Karlsson, G. Panayi, D. Erlinge, and O. Fröbert, for the iFR-SWEDEHEART Investigators*

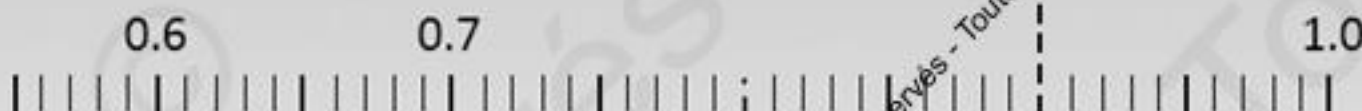
iFR-SWEDEHEART

DEFINE FLAIR



Clinical iFR and FFR Cut-points

iFR



FFR



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MACE composite endpoint of:

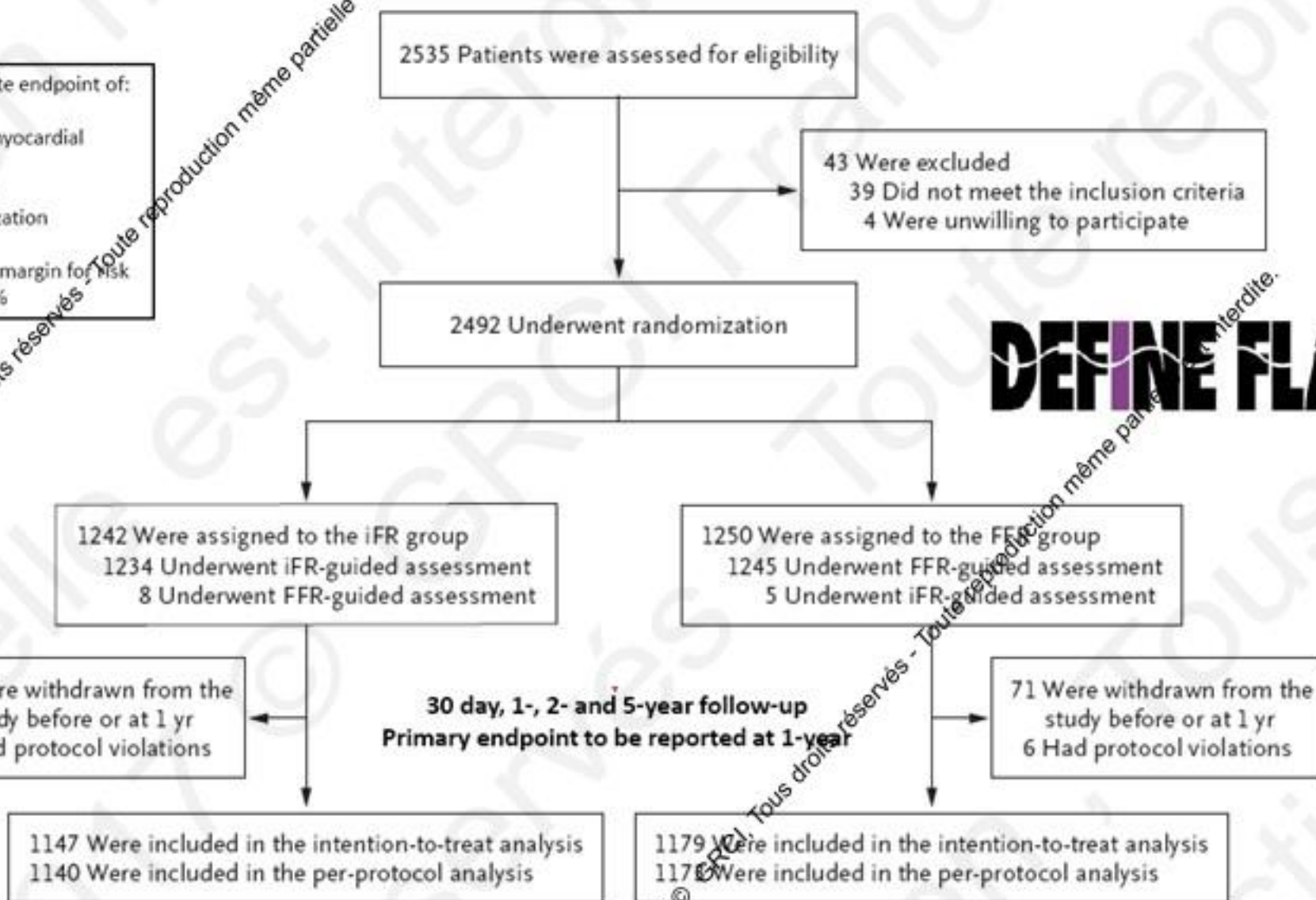
- Death
- Non-fatal myocardial infarction
- Unplanned revascularization

Non-inferiority margin for risk difference: 3.4%

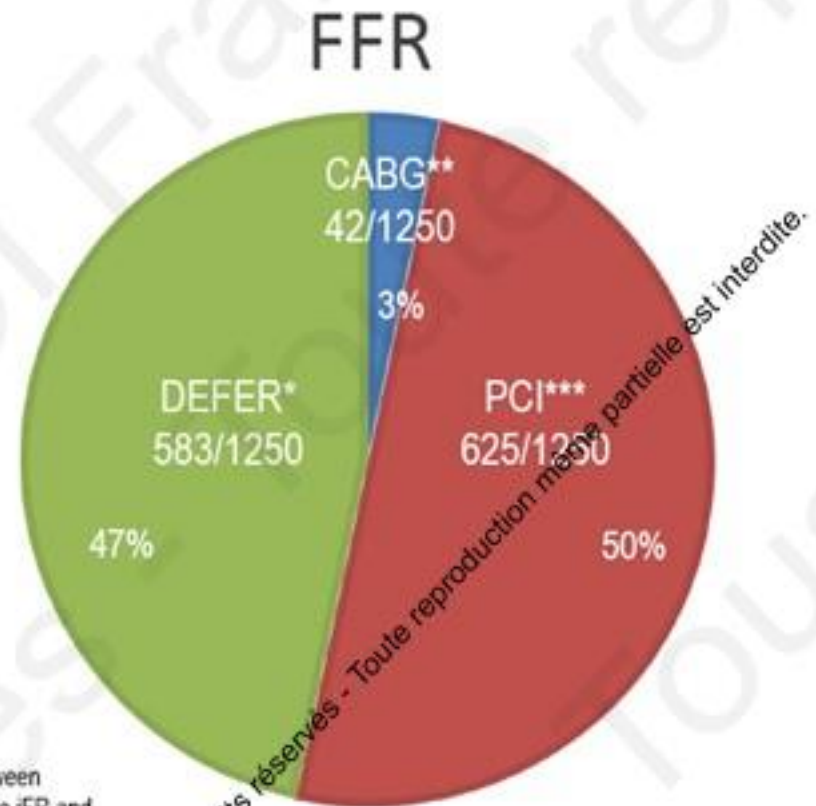
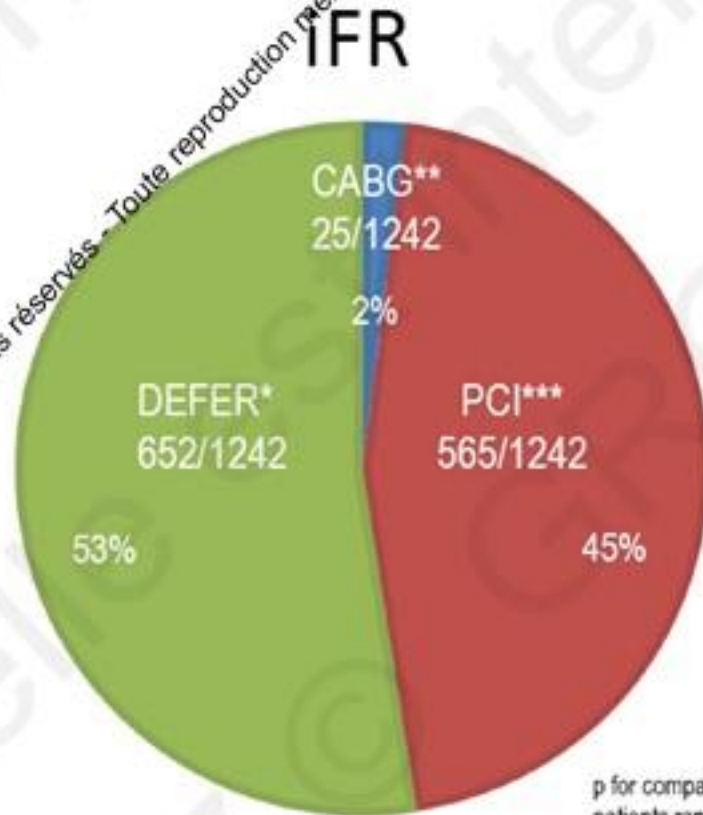
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Significantly less revascularization using iFR



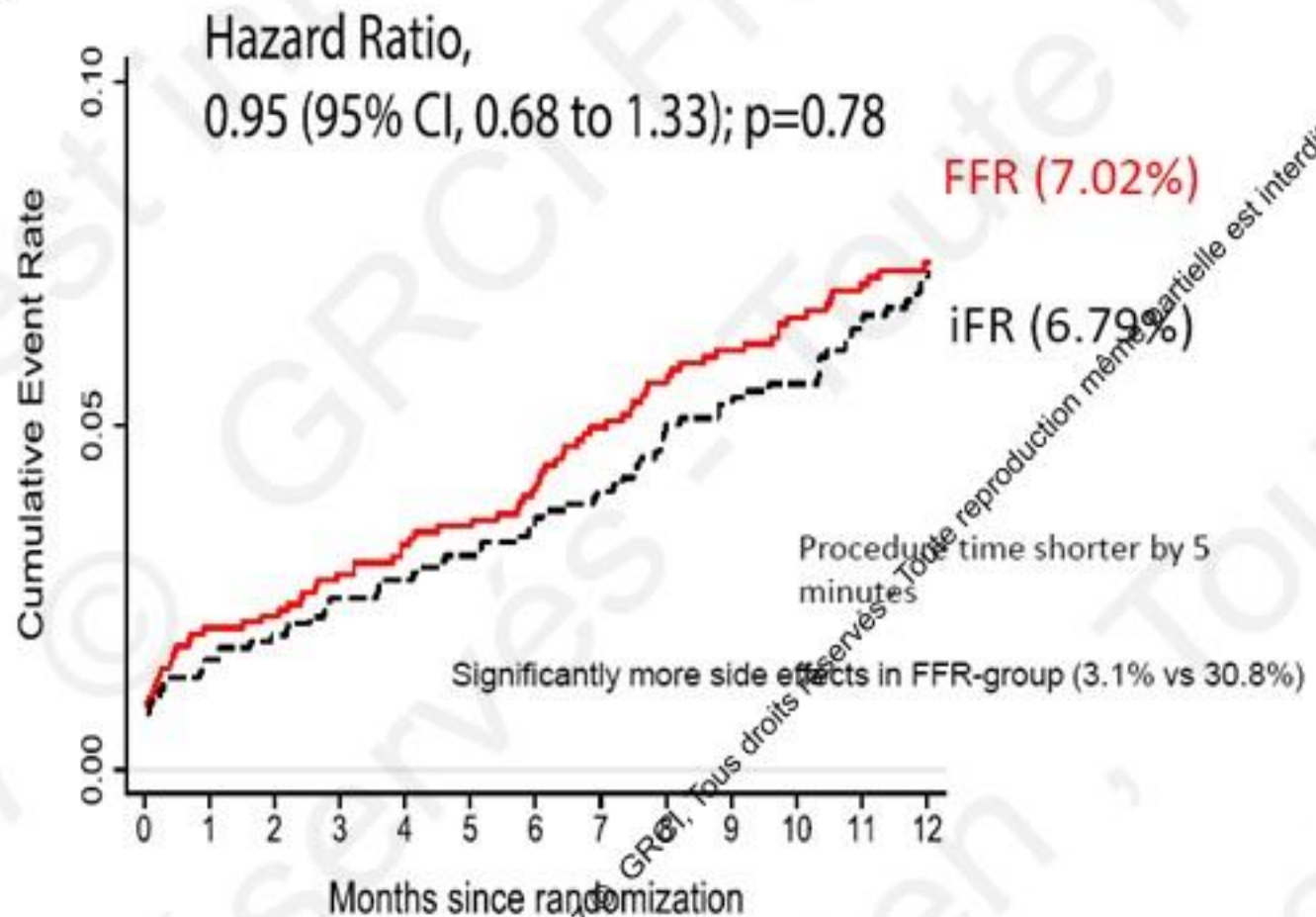
p for comparison between patients randomized to iFR and FFR

DEFER* p=0.003
CABG** p=0.04
PCI*** p=0.02

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Primary endpoint (MACE) iFR non-inferior to FFR with less PCI and CABG



MACE composite endpoint of:

- Death
- Non-fatal myocardial infarction
- Unplanned revascularization

Non-inferiority margin for risk difference: 3.4%

10,052 Patients were included in the SCAAR

2042 Were enrolled in the trial

5 Did not meet inclusion criteria or had consent withdrawn

2037 Underwent randomization

7 Were excluded
6 Were affected by technical issues
1 Had other reason (investigator decision)

1019 Were assigned to the iFR group

1012 Underwent iFR-guided revascularization

1019 Had follow-up

1018 Were assigned to the FFR group

1007 Underwent FFR-guided revascularization

1018 Had follow-up

11 Were excluded
4 Had incorrect group assignment
3 Had side effects from adenosine
2 Had other medical condition
2 Were affected by technical issues



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Baseline clinical characteristics

	IFR (N=1019)	FFR (N = 1018)
Age - yr. (mean (\pm SD))	67.6 (9.6)	67.4 (9.2)
Male sex - no. (%)	756 (74.2)	766 (75.3)
Indication for angiography - no. (%)		
Stable angina	632 (62.0)	632 (62.0)
Unstable angina	211 (20.7)	208 (20.4)
NSTEMI	176 (17.3)	178 (17.5)
Diabetes mellitus - no. (%)	232 (22.8)	213 (20.9)
Hypertension - no. (%)	730 (71.6)	710 (69.7)
Hyperlipidemia - no. (%)	733 (71.9)	704 (69.1)
Current smoker	159 (15.6)	167 (16.3)
Previous myocardial infarction - no. (%)	337 (33.1)	335 (32.9)
Previous PCI - no. (%)	420 (42.1)	425 (41.7)
Previous coronary artery by-pass grafting - no. (%)	49 (4.8)	43 (4.2)

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Procedural characteristics

	iFR (N=1012)	FFR (N = 1007)	P Value
Radial artery approach - no. (%)	841 (83.1)	811 (80.5)	0.13
Contrast use, ml (median (IQR))	110 (80-155)	115 (80-160)	0.10
Procedure time, min (IQR)	50.8 (13.8-87.8)	53.1 (18.1-88.1)	0.09
Fluoroscopy time, min (median (IQR))	10.5 (6.3-16.8)	10.2 (6.5-16.0)	0.57
Total no. of lesions evaluated	1568	1436	
Mean no. of lesions evaluated (SD)	1.55 (0.86)	1.43 (0.70)	0.002
Functionally significant lesions - no. (%)	457 (29.2)	528 (36.8)	<0.0001
Mean no. of functionally significant lesions per patient (SD)	0.45 (0.71)	0.52 (0.68)	0.05
Mean iFR value (SD)	0.91 (0.10)	-	-
Mean FFR value (SD)	-	0.82 (0.10)	-

More lesions evaluated in iFR-group
but fewer significant lesions

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Procedural characteristics (ii)

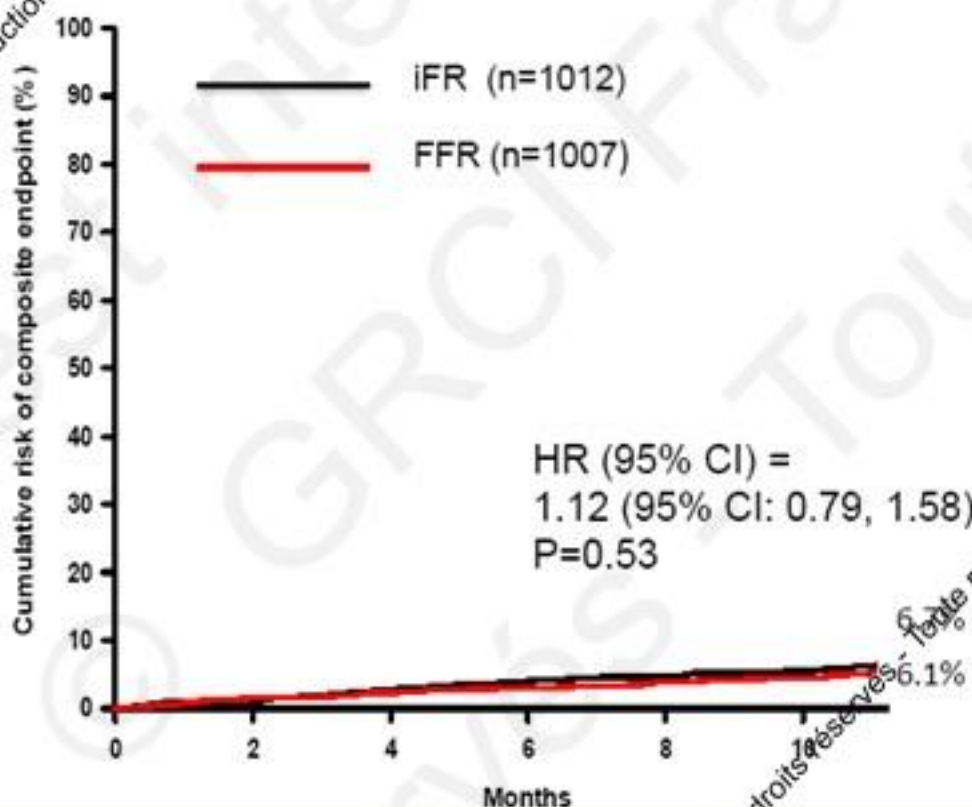
	IFR (N=1012)	FFR (N = 1007)	P Value
Treated vessel - no. (%)			0.68
Left Main	14 (1.5)	16 (1.6)	
LAD	434 (47.4)	469 (47.9)	
LCx	176 (19.3)	179 (18.3)	
RCA	164 (17.9)	196 (20.0)	
Missing data	127 (13.9)	120 (12.2)	
Mean no. of stents per patient undergoing PCI mean (SD)	1.58 (1.08)	1.73 (1.19)	0.048
Drug eluting stent - no. (%)	696 (99.7)	770 (97.8)	0.50
PCI as primary revascularization strategy - no. (%)	443 (43.8)	456 (45.3)	0.50
CABG as primary revascularization strategy - no. (%)	93 (9.2)	110 (11.2)	0.13
Total revascularization rates - no (%)	536 (53.0)	569 (56.5)	0.11

**Significantly more stents per patient in
FFR-group**

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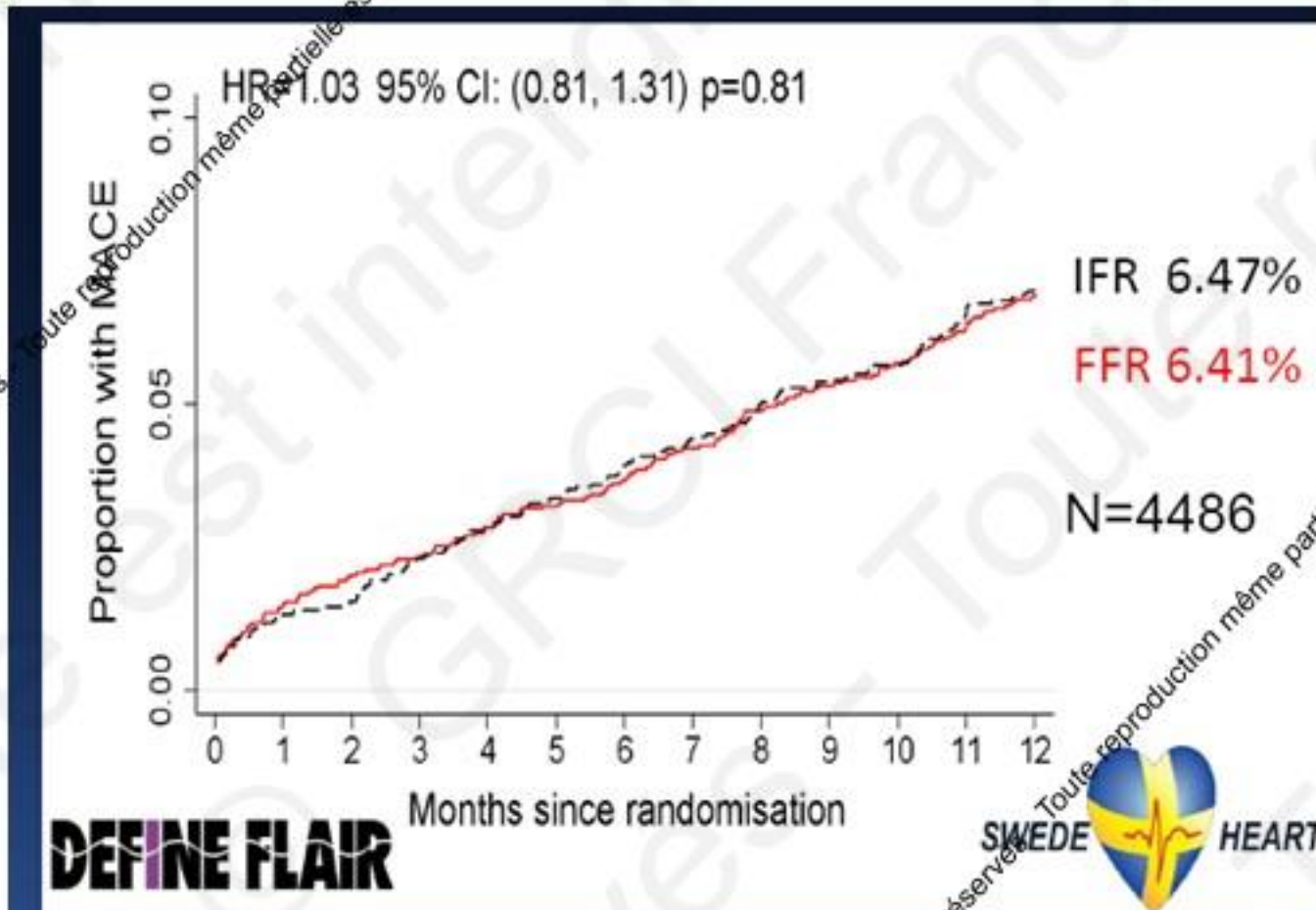
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iFR-SWEDHEART Primary Endpoint – iFR non-inferior to FFR



Pre-specified non-inferiority criteria met

Göteborg et al, NEJM 2017



DEFINE FLAIR

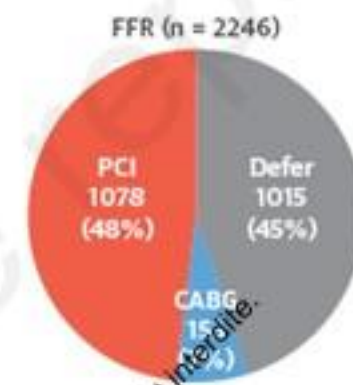
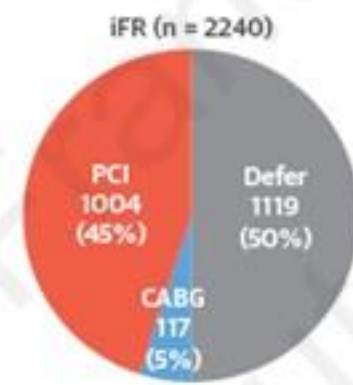


MACE similar and low at 1 year after iFR- and FFR-based revascularization decision-making

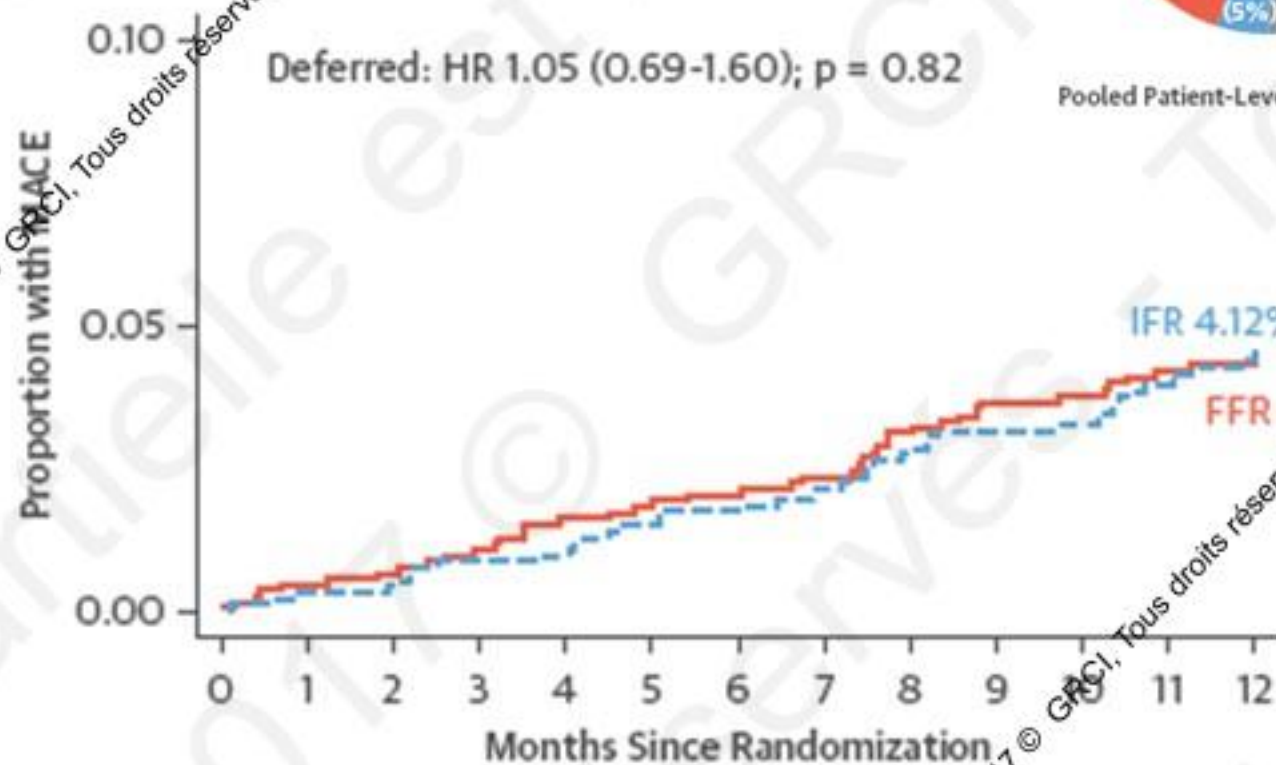
Escaned PCR 2017

iFR = gold standard of PCI ?

DEFINE FLAIR



Pooled Patient-Level Analysis of DEFINE FLAIR and iFR SWEDHEART Trials



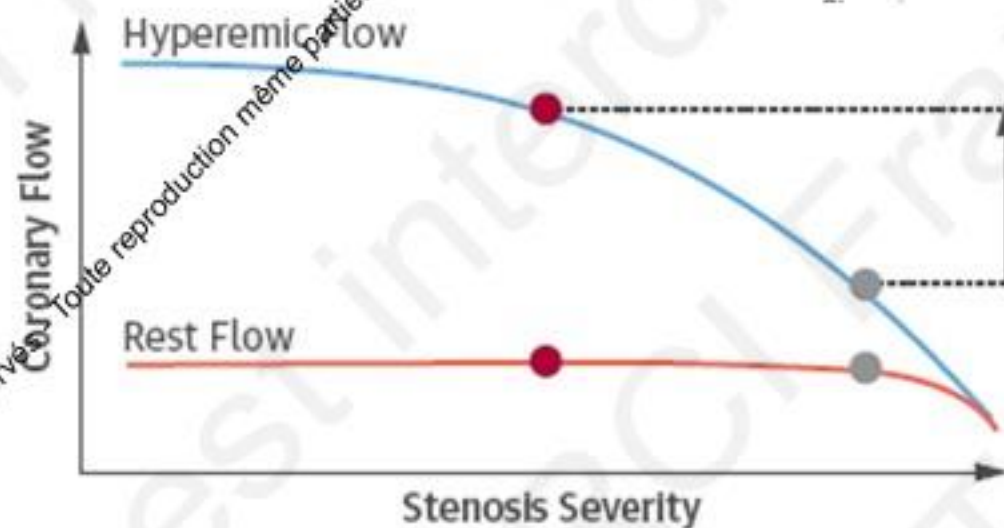
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iFR & situations particulières

- Lésions en Tandem ou athérosclérose diffuse

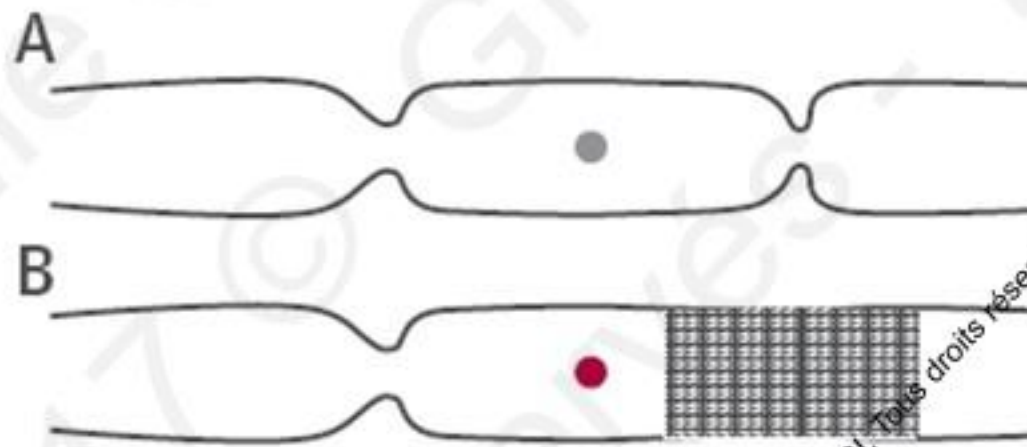
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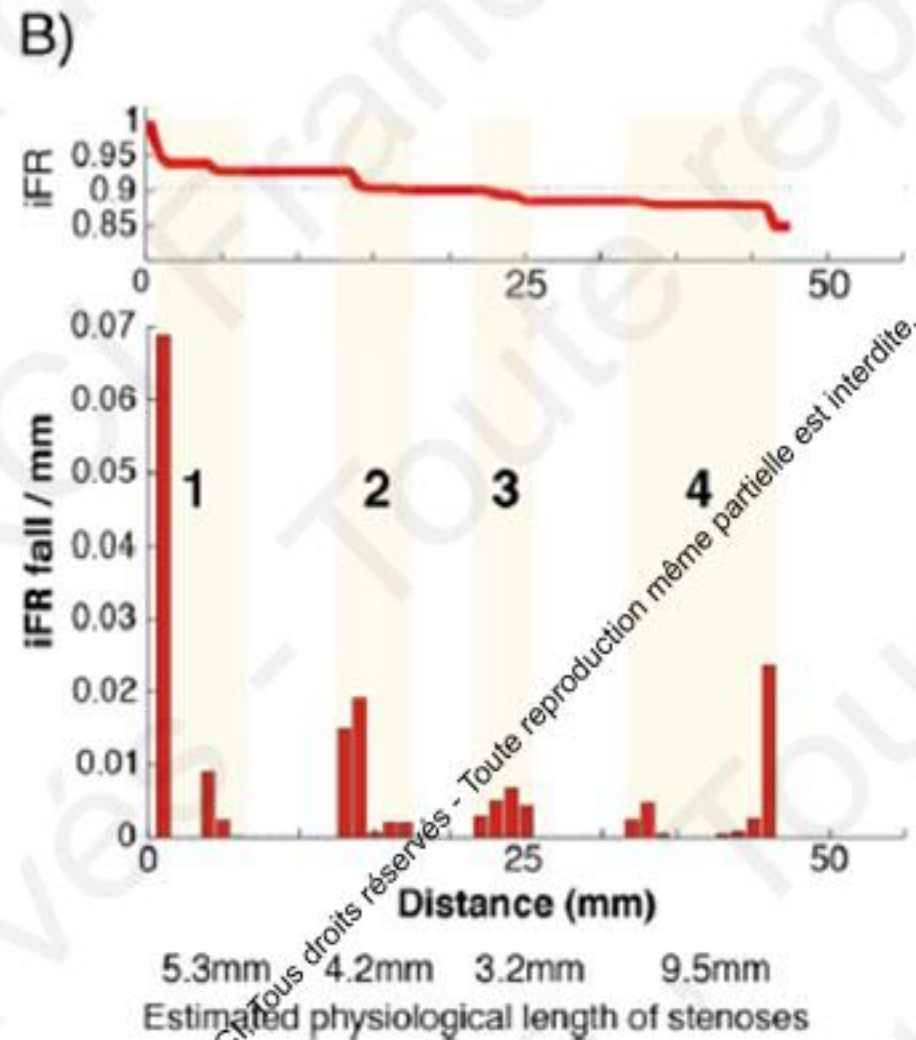
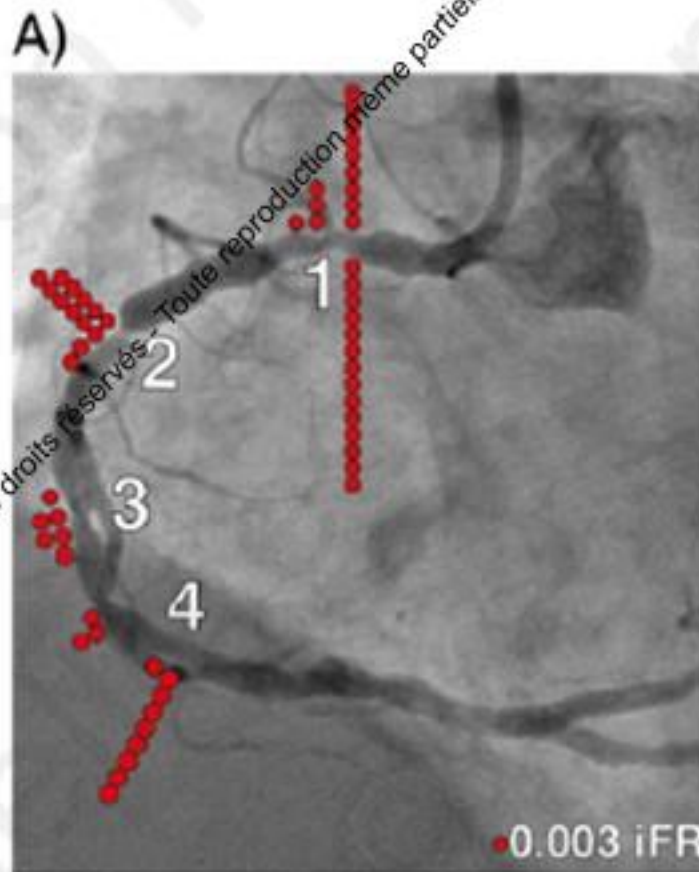
Increase in hyperemic flow after PCI

Minimal change in rest flow after PCI

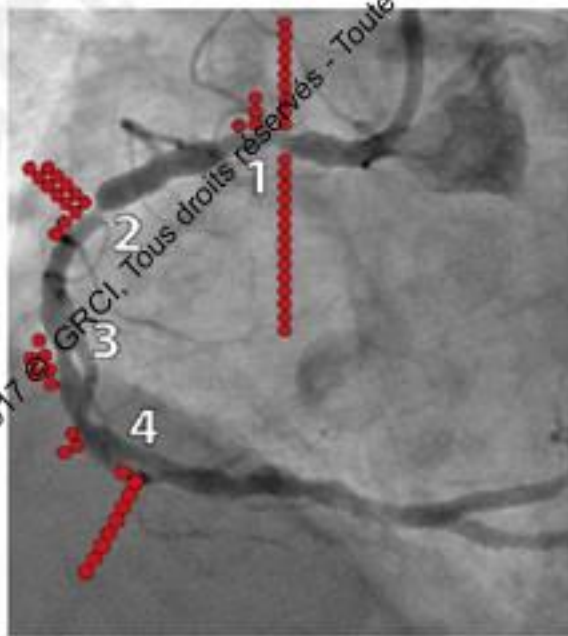


Rest and Hyperemic flow pre-PCI of distal lesion

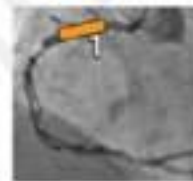
Rest and Hyperemic flow post-PCI of distal lesion



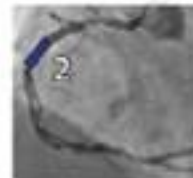
A) RCA with 4 distinct areas of pressure loss



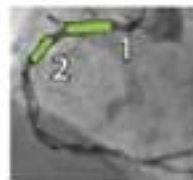
B) Different stenting strategies can be considered



1 only

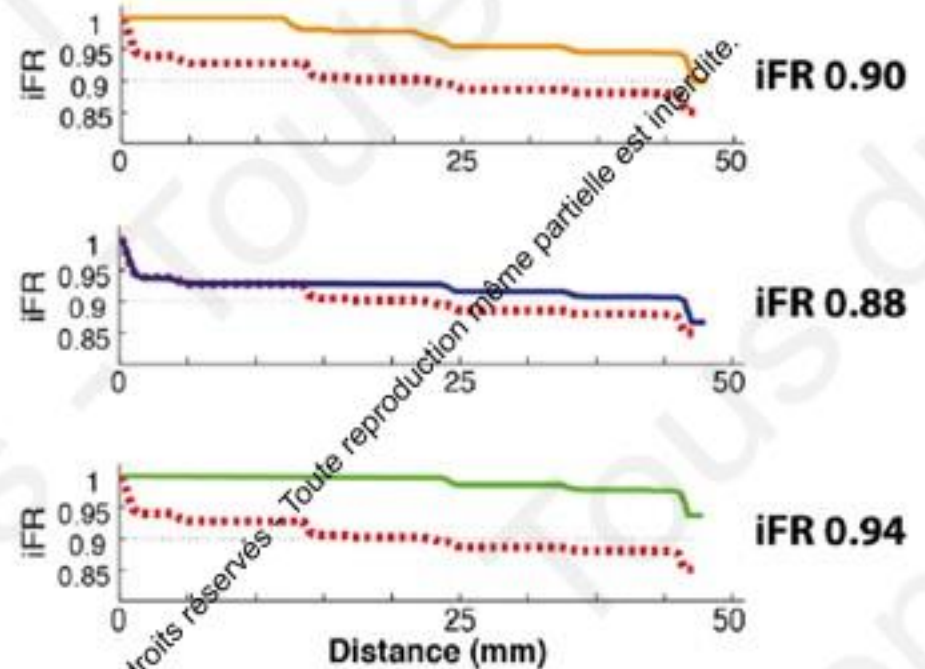


2 only

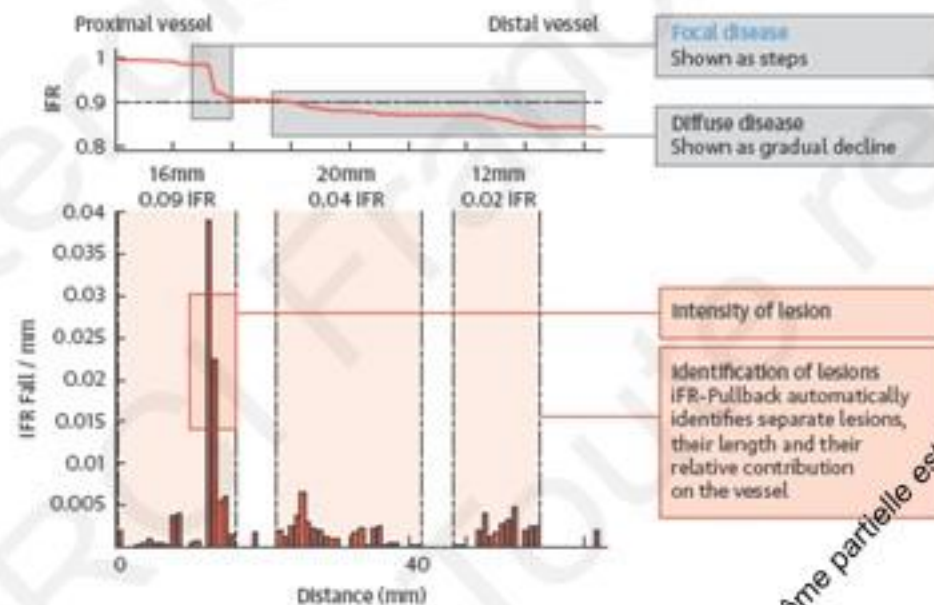
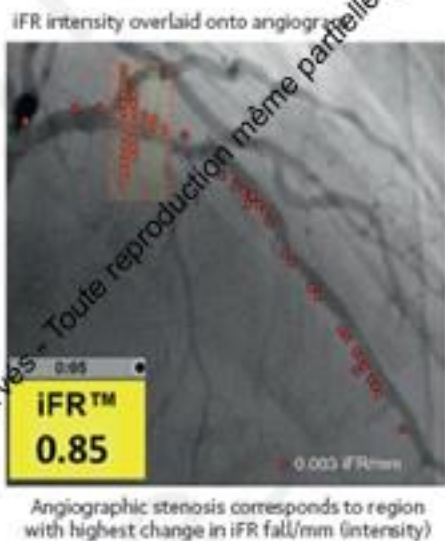


1 and 2

C) The physiological results of each stenting strategy can be predicted



A IFR Pullback Recording: IFR Through Vessel



B Prediction of Post-PCI IFR Result



Take Home Messages

Tools For Assessing Coronary Physiology To Guide Coronary Revascularization

Concerns With Resting Pd/Pa	Concerns With Coronary Flow Reserve (CFR)	Concerns With Fractional Flow Reserve (FFR)	Benefits of instantaneous wave-free ratio (iFR)
<ul style="list-style-type: none"> ⚠ Low diagnostic resolution ⚠ Low fidelity for serial stenosis assessment ⚠ Susceptible to miscalculation from pressure-wire drift ⚠ No patient outcome data 	<ul style="list-style-type: none"> ⚠ Lack of a definitive normal value ⚠ Influenced by hemodynamics, loading conditions, and contractility ⚠ Hyperemia required 	<ul style="list-style-type: none"> ⚠ Lengthy procedure ⚠ Adenosine-associated costs ⚠ Low availability of adenosine ⚠ Inability to assess serial lesions ⚠ High incidence of patient-related discomfort 	<ul style="list-style-type: none"> ✓ Hyperemia independent ✓ Superior signal-to-noise ratio compared to Pd/Pa ✓ Quicker than FFR ✓ Low incidence of patient-related discomfort ✓ Ability to assess serial lesions and predict post PCI iFR outcome

iFR as the Gold Standard Index!

Justin E Davies

TCT 2017

Imperial College
London

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