PLACE 2026
PLATFORM OF LABORATORIES FOR ADVANCES IN CARDIAC EXPERIENCE

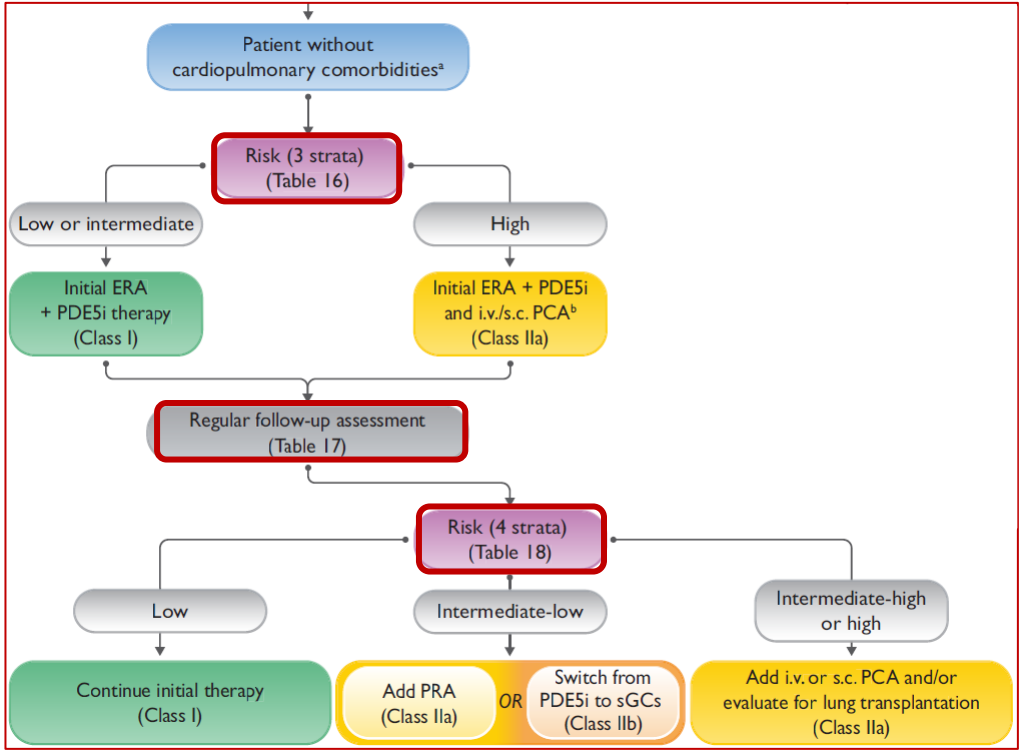
CONGRESSO
ROMA, 25 - 27 Giugno 2026

## Ipertensione polmonare: tra certezze e dubbi

# La stratificazione del rischio: come l'eco può aiutare

Silvia Papa

Treatment algorithm in PAH



# Risk stratification and medical therapy of pulmonary arterial hypertension

Nazzareno Galiè[1], Richard N. Channick[2], Robert P. Frantz[3], Ekkehard Grünig[4], Zhi Cheng Jing[5], Olga Moiseeva[6], Ioana R. Preston[7], Tomas Pulido[8], Zeenat Safdar[9], Yuichi Tamura[10] and Vallerie V. McLaughlin[11]

TABLE 1 Summary of four registries assessing risk scores

| | REVEAL [17–19] | Swedish PAH Register [6] | COMPERA [7] | French Pulmonary Hypertension Network [8]# |
|---|---|---|---|---|
| Required variables n | 12–14 | 8 | 8 | 4 |
| Patients at baseline n | 2716 | 530 | 1588 | 1017 |
| Patients at follow-up n | 2529 | 383 | 1094 | 1017 |
| Associated PAH included | Yes | Yes | Yes | No |
| Definition of low risk | ⩽6 REVEAL score | <1.5 average score | <1.5 average score | 3–4 out of 4 low-risk criteria |
| 1-year mortality by risk group (low/intermediate/high) % | ⩽2.6/7.0/⩾10.7 | 1.0/7.0/26.0 | 2.8/9.9/21.2 | 1.0/NA/13.0–30.0 |

PAH: pulmonary arterial hypertension; NA: not available. #: incident patients only.

## Reveal

1. WHO-FC
2. 6MWD
3. BNP
4. **RAP**
5. Heart rate
6. SBP
7. Renal failure
8. P. Effusion
9. **PVR**
10. DLCO
11. Sex age
12. PAH Type

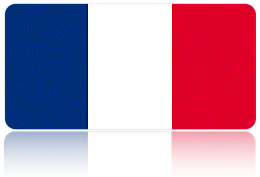
## Reveal 2.0

1. WHO-FC
2. 6MWD
3. BNP
4. **RAP**
5. Heart rate
6. SBP
7. Renal failure
8. P. Effusion
9. **PVR**
10. DLCO
11. Sex age
12. PAH Type
13. Hospitalization 6 months

## Reveal 2.0 lite

1. WHO-FC
2. 6MWD
3. BNP
4. Heart rate
5. SBP
6. Renal failure

## French



1. WHO-FC
2. 6MWD
3. NT-proBNP
4. **RAP**
5. **Cardiac index**

## Swedish

1. WHO-FC
2. 6MWD
3. NT-proBNP
4. **RAP**
5. **Cardiac index**
6. **SvO2**
7. RA area
8. Pericardial effusion

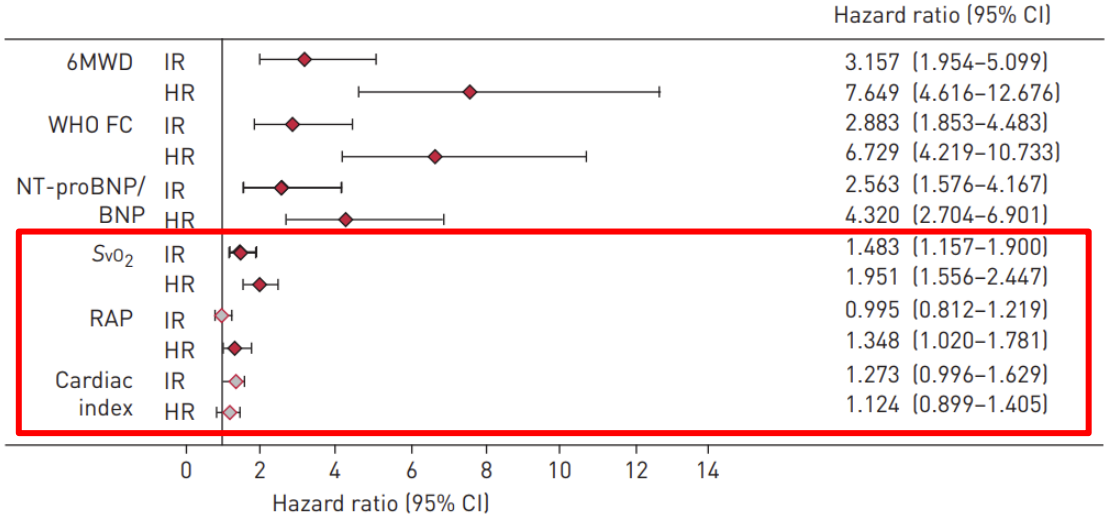
## Compera

1. WHO-FC
2. 6MWD
3. NT-proBNP
4. **RAP**
5. **Cardiac index**
6. **SvO2**

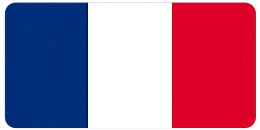
# Average score method (Swedish and Compera)

## Variables contribution to predicting survival

Independent prognostic information




Hoeper M. ERJ 2017;50:1700740

| Reveal | Reveal 2.0 | Reveal 2.0 lite | French | Swedish | Compera |
|---|---|---|---|---|---|
|  |  |  |  |  |  |
| 1. **WHO-FC** | 1. **WHO-FC** | 1. **WHO-FC** | 1. **WHO-FC** | 1. **WHO-FC** | 1. **WHO-FC** |
| 2. **6MWD** | 2. **6MWD** | 2. **6MWD** | 2. **6MWD** | 2. **6MWD** | 2. **6MWD** |
| 3. **BNP** | 3. **BNP** | 3. **BNP** | 3. **NT-proBNP** | 3. **NT-proBNP** | 3. **NT-proBNP** |
| 4. RAP | 4. RAP | 4. Heart rate | 4. RAP | 4. RAP | 4. RAP |
| 5. Heart rate | 5. Heart rate | 5. SBP | 5. Cardiac index | 5. Cardiac index | 5. Cardiac index |
| 6. SBP | 6. SBP | 6. Renal failure | | 6. SvO2 | 6. SvO2 |
| 7. Renal failure | 7. Renal failure | | | 7. RA area | |
| 8. P. Effusion | 8. P. Effusion | | | 8. Pericardial effusion | |
| 9. PVR | 9. PVR | | | | |
| 10. DLCO | 10. DLCO | | | | |
| 11. Sex age | 11. Sex age | | | | |
| 12. PAH Type | 12. PAH Type | | | | |
| | 13. Hospitalization 6 months | | | | |

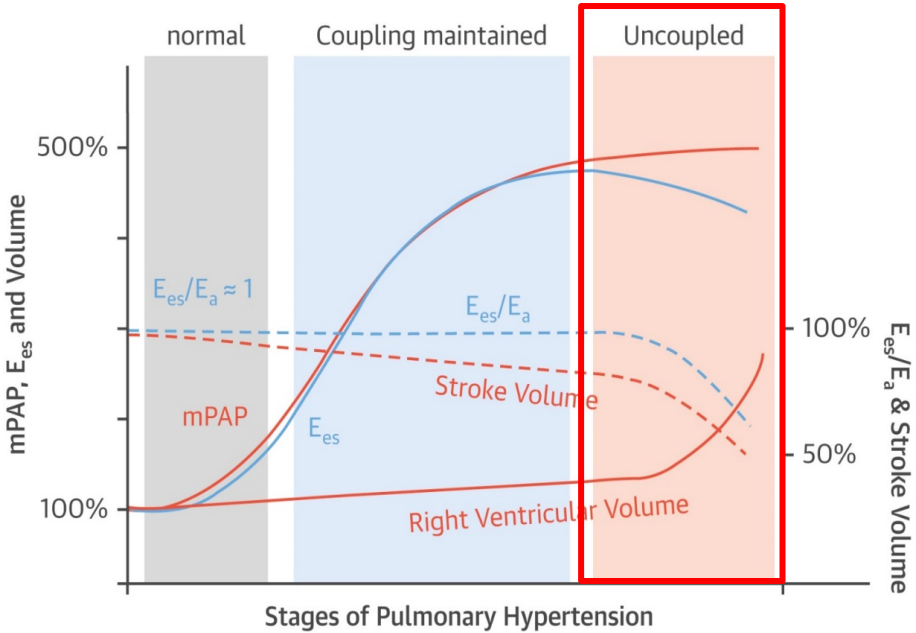
| | | |
|---|---|---|
| For risk stratification during follow-up, the use of a four-strata model (low, intermediate–low, intermediate–high, and high risk) based on WHO-FC, 6MWD, and BNP/NT-proBNP is recommended, with additional variables taken into account as necessary[280,308] | I | B |

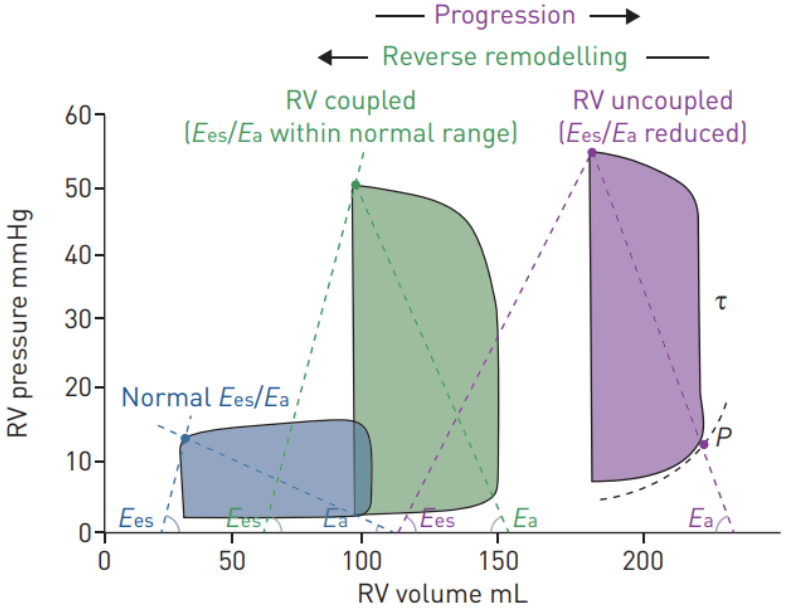
….at follow-up, the four-strata model is rec… …asic risk-stratification tool

| Determinants of prognosis | Low risk | …iate–low risk | Intermediate–high risk | High risk |
|---|---|---|---|---|
| Points assigned | | 2 | 3 | 4 |
| WHO-FC | | - | III | IV |
| 6MWD, m | …40 | 320–440 | 165–319 | <165 |
| BNP or | <50 | 50–199 | 200–800 | >800 |
| NT-pro… | <300 | 300–649 | 650–1100 | >1100 |

with additional variables taken into account as necessary[280,308]

# RV load vs RV response




Vonk Noordegraaf et al. J Am Coll Cardiol 2017

# Imaging-derived variables

**Table S2** **Imaging-derived variables of prognostic relevance and cut-off values in pulmonary arterial hypertension**

| | Increased risk | Decreased risk | Ref. |
|---|---|---|---|
| **Echocardiography** | | | |
| **Right heart morphology** | | | |
| RVESRI | ≥1.6 | NA | 122 |
| Δ RVEDA, $cm^2$ | NA | <−2.45 | 123 |
| RV/LV ratio | >1 | NA | NA |
| Δ RA area, $cm^2$ | NA | <−1.30 | 123 |
| Δ LVEIs | NA | <−0.12 | 123 |
| Tricuspid regurgitation, severe | Yes | NA | 124 |
| **RV systolic function** | | | |
| TAPSE, mm | ≤17 | NA | 125 |
| TAPSE/sPAP, mm/mmHg | <0.19 | >0.55 | 118 |
| RV-FAC, % | <36.5 | NA | 126 |
| IVCv, cm/s | ≤9 | NA | 127 |
| **RV filling pressure** | | | |
| Pericardial effusion | Yes | NA | 128,129 |
| RV post-systolic strain pattern[a] | 2–3 | NA | 130 |
| **RV dyssynchrony**[b] | | | |
| RV-SD4, ms | >23 | ≤18 | 131 |

## Suggested assessment and timing for the follow-up of patients with PAH

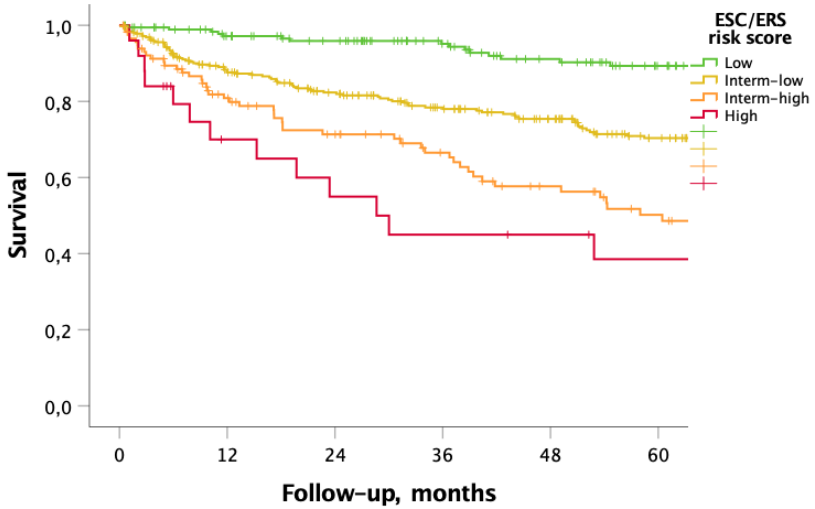
| | At baseline | 3–6 months after changes in therapy[a] | Every 3–6 months in stable patients[a] | In case of clinical worsening |
|---|---|---|---|---|
| Medical assessment (including WHO-FC) | | | | |
| 6MWT | | | | |
| Blood test (including NT-proBNP)[b,c] | | | | |
| ECG | | | | |
| Echocardiography or cMRI | | | | |
| ABG or pulse oximetry[d] | | | | |
| Disease-specific HR-QoL | | | | |
| CPET | | | | |
| RHC | | | | |

Green: is indicated; yellow: should be considered; orange: may be considered.



# RV function at follow-up and outcome in PAH

677 PAH patients (55 % idiopathic)
11 italian centers – iPHNET –
Different treatment strategies (most oral monotherapy)
median follow-up for II observation, 293 days (IQR 180-344)

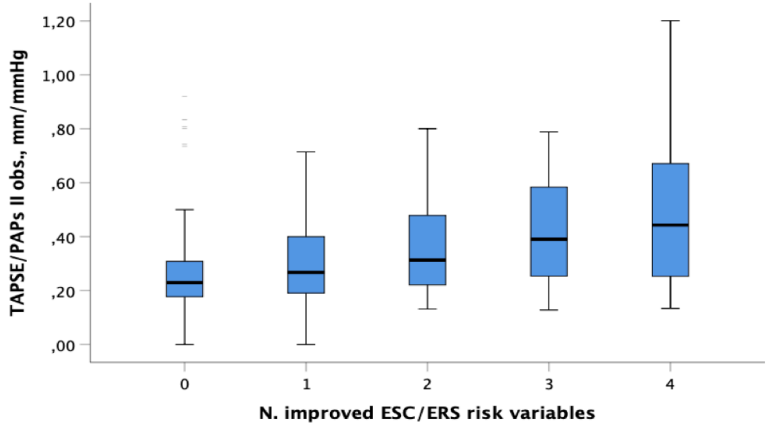



IPHNET data

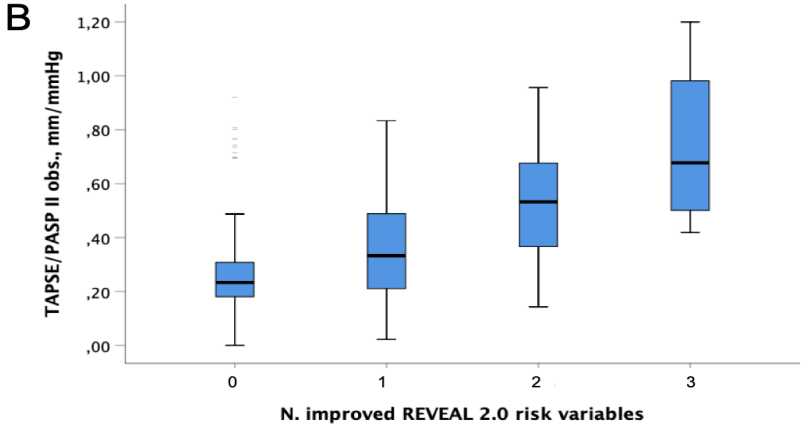
# Improved RV function and risk variables in PAH

677 PAH patients (55 % idiopathic)
11 italian centers – iPHNET –
Different treatment strategies (most oral monotherapy)
median follow-up for II observation, 293 days (IQR 180-344)

A




B




IPHNET data

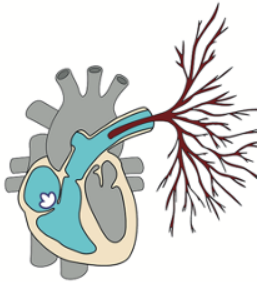
# RV function at follow-up and outcome in PAH

677 PAH patients (55 % idiopathic)
11 italian centers – iPHNET –
Different treatment strategies (most oral monotherapy)
median follow-up for II observation, 293 days (IQR 180-344)

| | LOW | | INTERMEDIATE-LOW | | INTERMEDIATE-HIGH | | HIGH | |
|---|---|---|---|---|---|---|---|---|
| Estimated 1-year mortality | < 5% | | 5-20% | | | | > 20% | |
| **WHO FC**<br>**6MWD**<br>**NT-ProBNP** | | | | | | | | |
| Observed 1-year mortality | 0% | 4% | 6% | 15% | 9% | 26% | 25% *ns* | 35% *ns* |
| **TAPSE/sPAP**, mm/mmHg | **> 0.50** | **≤ 0.50** | **> 0.35** | **≤ 0.35** | **> 0.30** | **≤ 0.30** | **> 0.30** | **≤ 0.30** |

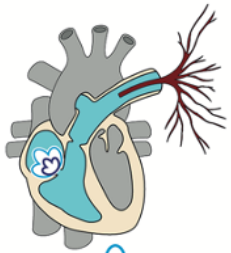
1015 incident PAH pts
11 italian centers – iPHNET
–

# RV phenotyping (echo-derived) and risk strata



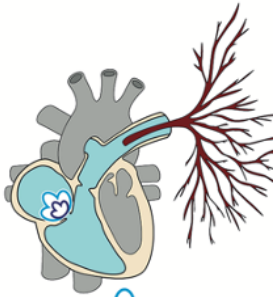
PHENOTYPE 1

- RVEDA/LVEDA ≤1
- TAPSE/PASP >0.33
- mild-moderate TR



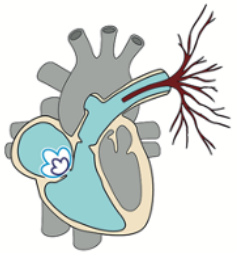
PHENOTYPE 2

- RVEDA/LVEDA ≤1
- TAPSE/PASP ≤0.33
- all TR



PHENOTYPE 3

- RVEDA/LVEDA >1
- TAPSE/PASP >0.33
- all TR



PHENOTYPE 4R- | PHENOTYPE 4R+

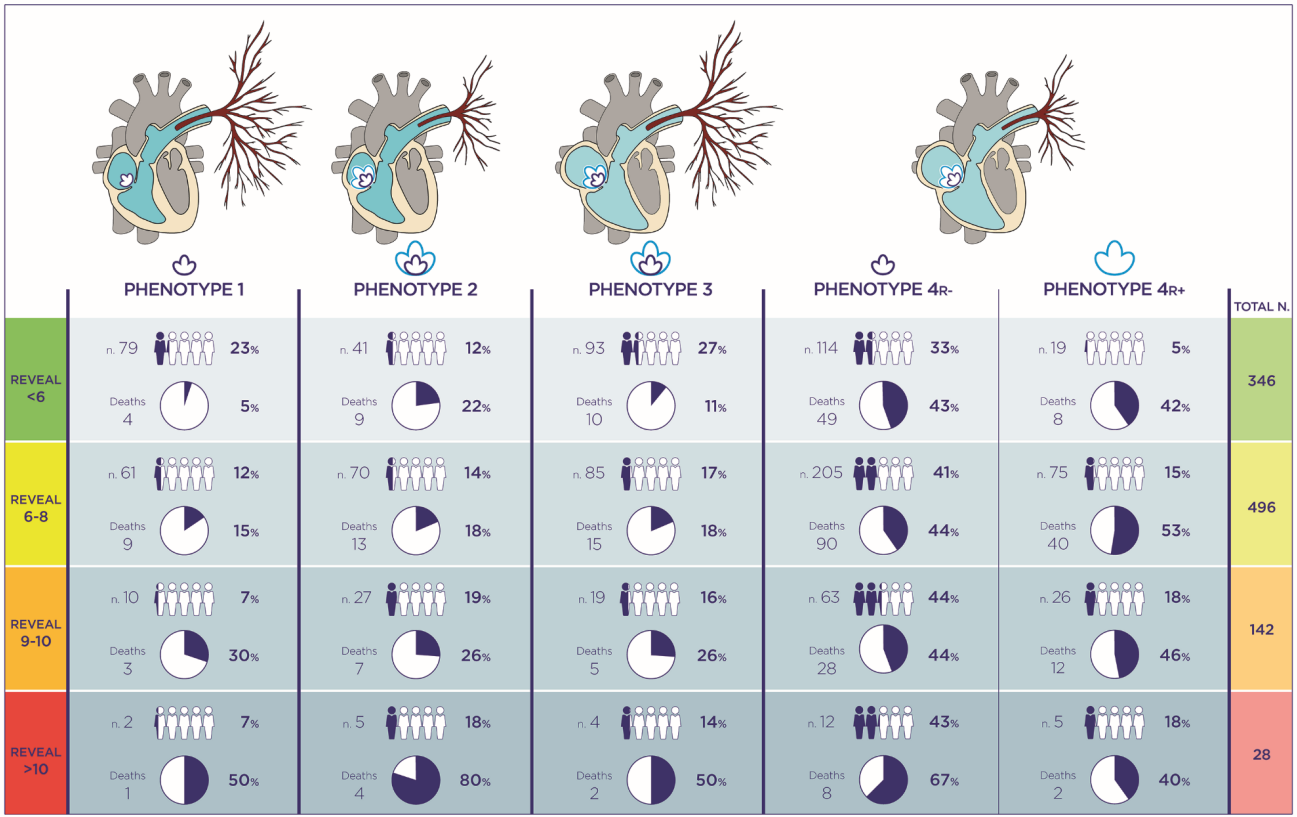
- RVEDA/LVEDA >1
- TAPSE/PASP ≤0.33

Progressive severity of RV maladaptation to failure

1015 incident PAH patients
11 italian centers – iPHNET –

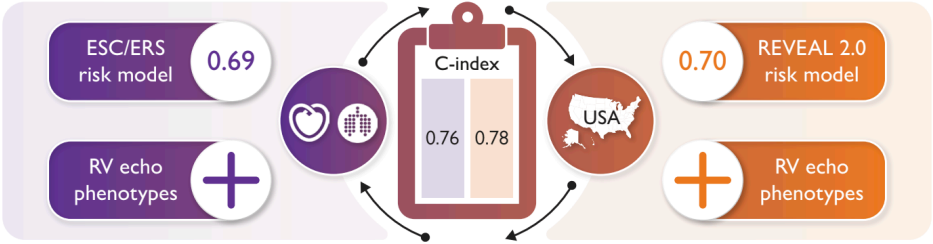
-Different treatment strategies (most oral monotherapy)
- 29% double oral
- 6% prosta-oral
- 3.4% triple with prosta

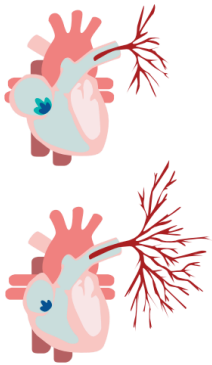
-Follow-up, median 3.1 y
31% deaths

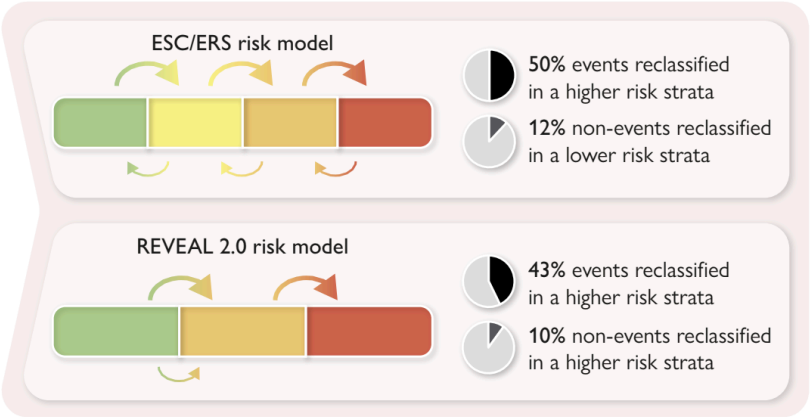


# Pulmonary arterial hypertension: right ventricular phenotyping to improve risk assessment at follow-up

Stefano Ghio [1,*†], Roberto Badagliacca[2,†], Michele D'Alto [3], Mauro Acquaro [1], Pietro Ameri[4,5], Paola Argiento[3], Natale Daniele Brunetti[6], Gavino Casu [7], Nadia Cedrone[8], Marco Confalonieri[9], Marco Corda[10], Michele Correale[11], Carlo D'Agostino[12], Elisabetta De Tommasi[12], Domenico Filomena[2], Giuseppe Galgano[13], Alessandra Greco[1], Massimo Grimaldi [13], Carlo Lombardi[14], Rosalinda Madonna[15], Giovanna Manzi[2], Valentina Mercurio[16], Massimiliano Mulè[17], Giuseppe Paciocco[18], Silvia Papa[2], Tommaso Recchioni[2], Antonella Romaniello[19], Emanuele Romeo [3], Laura Scelsi [1], Davide Stolfo [20], Marco Vatrano[21], Patrizio Vitulo[22], and Carmine Dario Vizza[2]; on behalf of the Italian Pulmonary Hypertension NETwork (IPHNET)



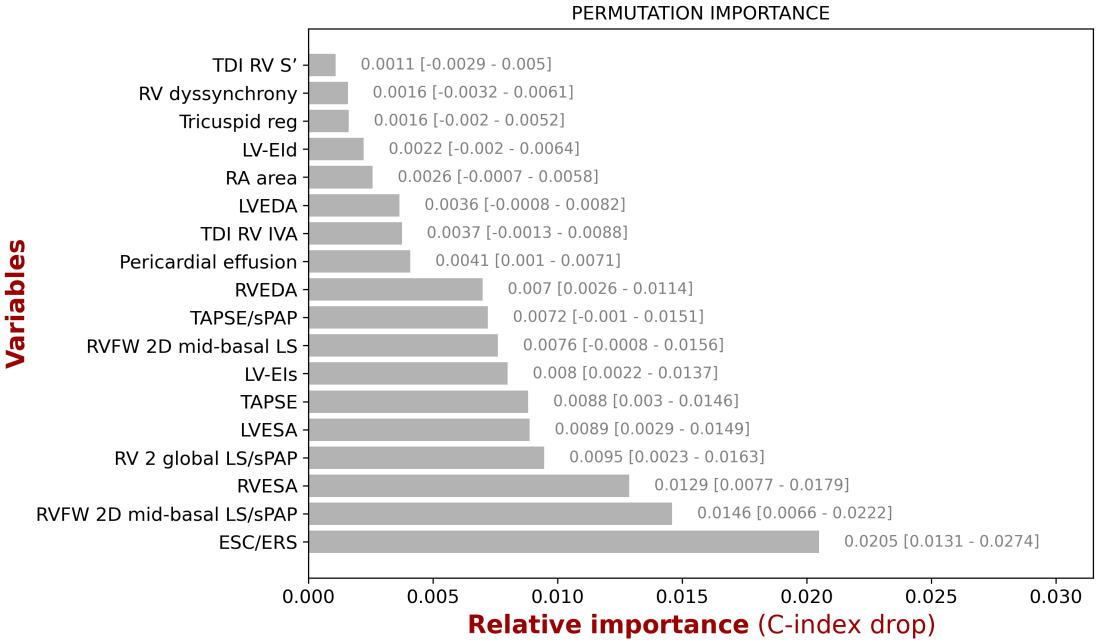






# ULTRAsound RIGHt venTricular eVALUation in pulmonary arterial hypErtension study

## Improvement of accuracy by echocardiography on top of ESC/ERS risk score

A.I. Machine Learning – Genetic Algorithm for feature selection and Random Survival Forest for accuracy assessment
Training and test crossvalidation was performed.




EHJ CVI, submitted

# ULTRAsound RIGHt venTricular eVALUation in pulmonary arterial hypErtension study

## Improvement of accuracy by echocardiography on top of REVEAL 2.0 risk score

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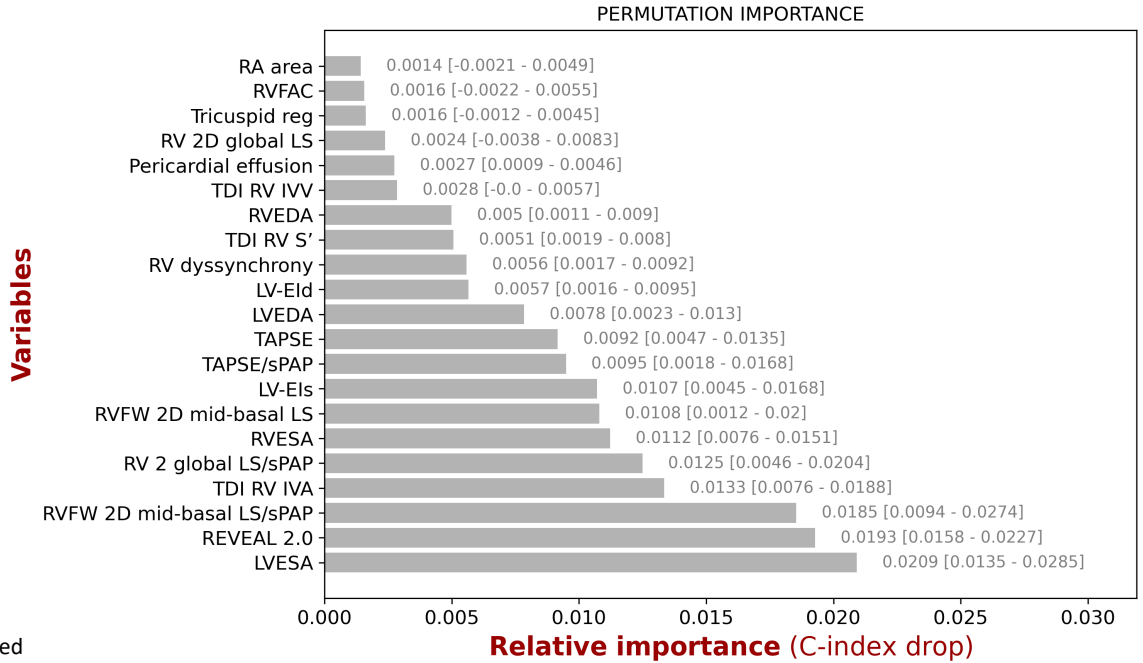
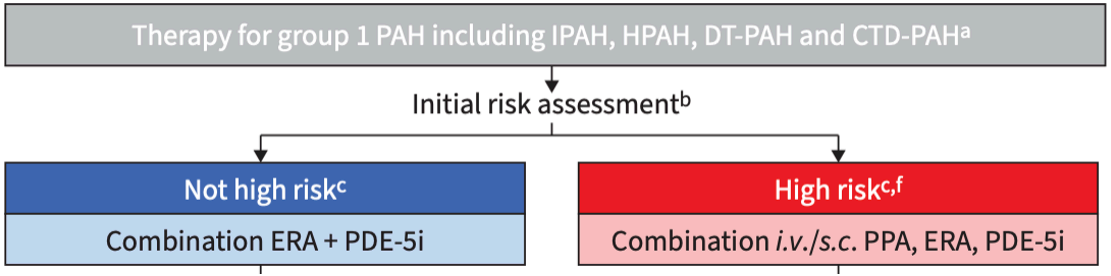
Training and test cross-validation were performed.




EHJ CVI, submitted

# Evidence-based treatment algorithm for idiopathic, heritable, drug-associated, and CTD-PAH

## 7th World Symposium on Pulmonary Hypertension




***Initial triple therapy*** with an *i.v./s.c.* PPA is recommended in high-risk patients and may be considered in non-high risk with severe haemodynamics and/or poor RV function.

Chin KM, Eur Respir J 2024

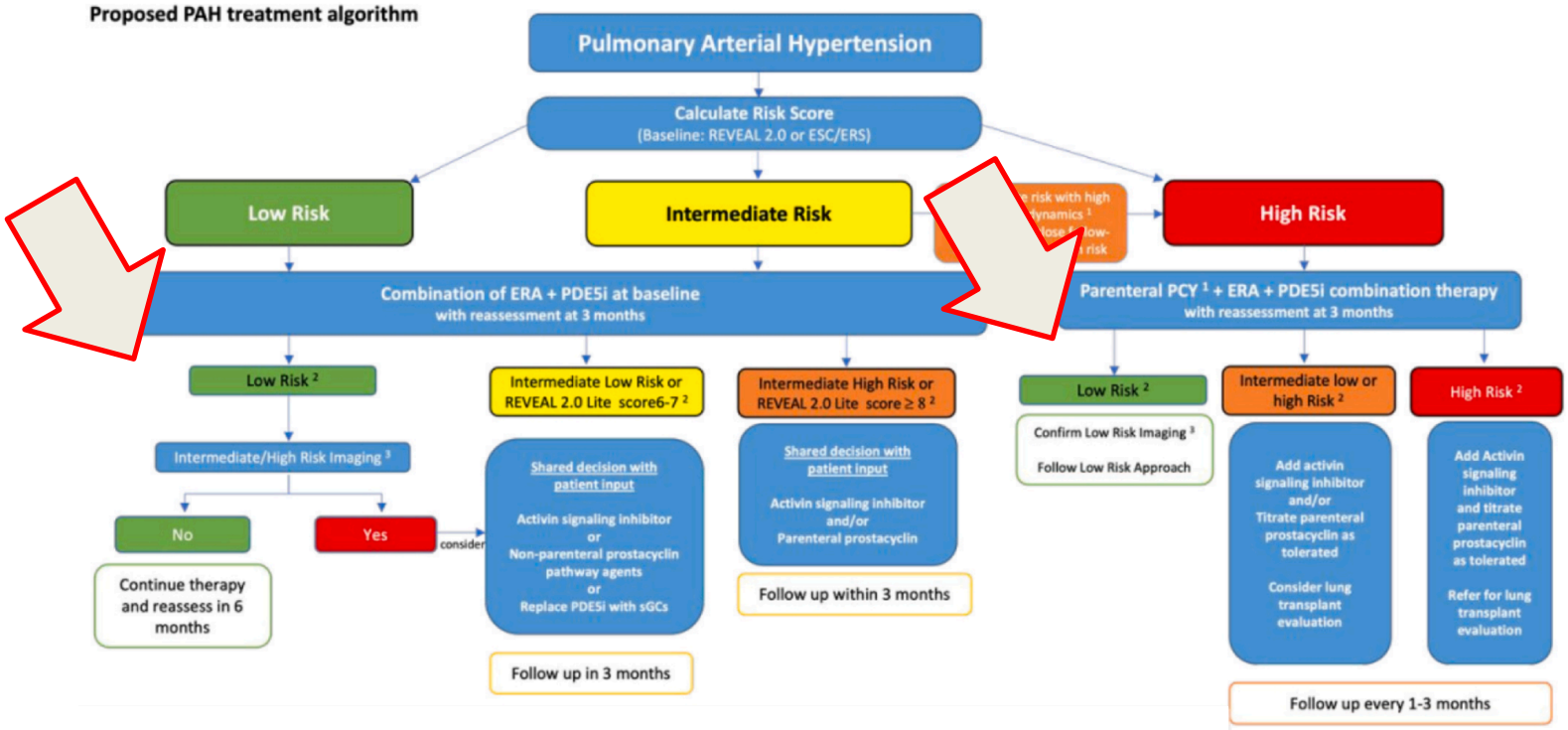
CONSENSUS STATEMENT

# International Society for Heart and Lung Transplantation (ISHLT) Consensus Statement on Risk Stratification in Pulmonary Arterial Hypertension

Sandeep Sahay,[a,1] Scott Visovatti,[b] Adriano R. Tonelli,[c] Nelson Villasmil Hernandez,[d] Eric D. Austin,[e] Roberto Badagliacca,[f] Rolf M.F. Berger,[g] Athénaïs Boucly,[h] Yucheng Chen,[i] Colin Church,[j] Marion Delcroix,[k] Allen D. Everett,[l] Harrison W. Farber,[m] Charles Fauvel,[n] Mardi Gomberg-Maitland,[o] Megan Griffiths,[ad] Francois Haddad,[p] Yuchi Han,[q] Anna Hemnes,[e] Marius M. Hoeper,[r] Manreet K. Kanwar,[s] Daniel Lachant,[t] Sandhya Murthy,[u] Karen M. Olsson,[r] Ioana Preston,[v] Göran Rådegran,[w] Olivier Sitbon,[x] Maria G. Trivieri,[y] Jean-Luc Vachiery,[z] Rebecca Vanderpool,[b] Jason Weatherald,[aa] R. James White,[t] Helen Whitford,[ab] Melisa Wilson,[ac] and Raymond L. Benza,[y,1]

J Heart Lung Transplant. 2025 Nov;44(11):e73-e131. doi: 10.1016/j.healun.2025.04.015

# *Let's shift the paradigm of treatment success. True success: low-risk imaging*




J Heart Lung Transplant. 2025 Nov;44(11):e73-e131. doi: 10.1016/j.healun.2025.04.015

EHJ CVI, submitted

# Key points

- ✓ PAH is mainly an afterload mismatch disease and the RV is the principal determinant of prognosis
- ✓ Application of the 4-strata model improves discrimination at follow-up assessment
- ✓ RV imaging may further improve prognostication in incident and prevalent patients.
- ✓ The best timing to collect imaging variables and their prognostic relevance are yet to be defined.