Pourquoi et comment mettre en place un parcours de soins de l'embolie pulmonaire ?

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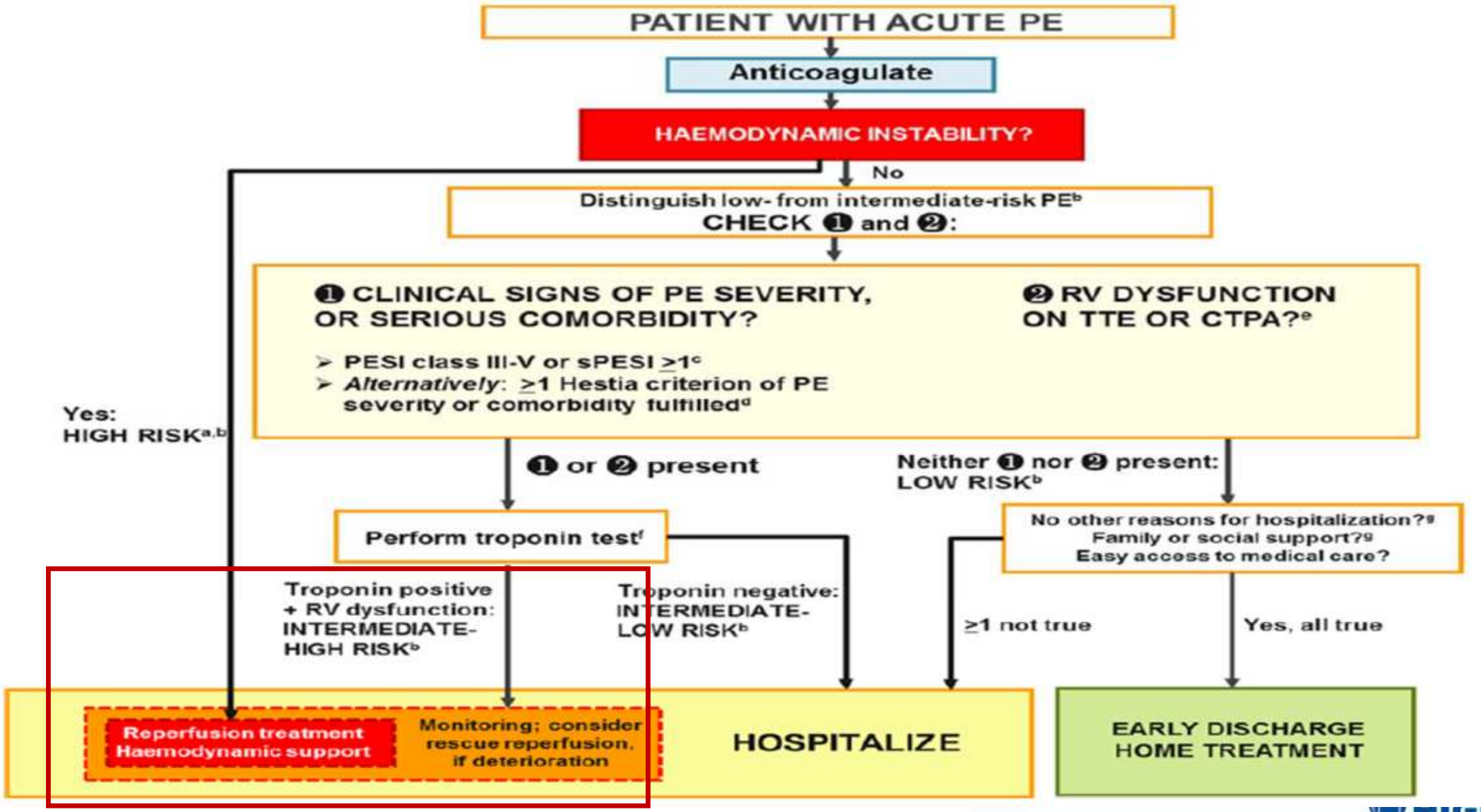
CONFLITS D'INTÉRÊTS

Speaker's name : Nicolas Meneveau

☑ I have the following potential conflicts of interest to report

Consulting fees - Abbott Medical
Consulting fees - INARI
Consulting fees - TERUMO
Honoraria - AstraZeneca
Consulting fees - Edwards Lifesciences
Consulting fees - Boston Scientific

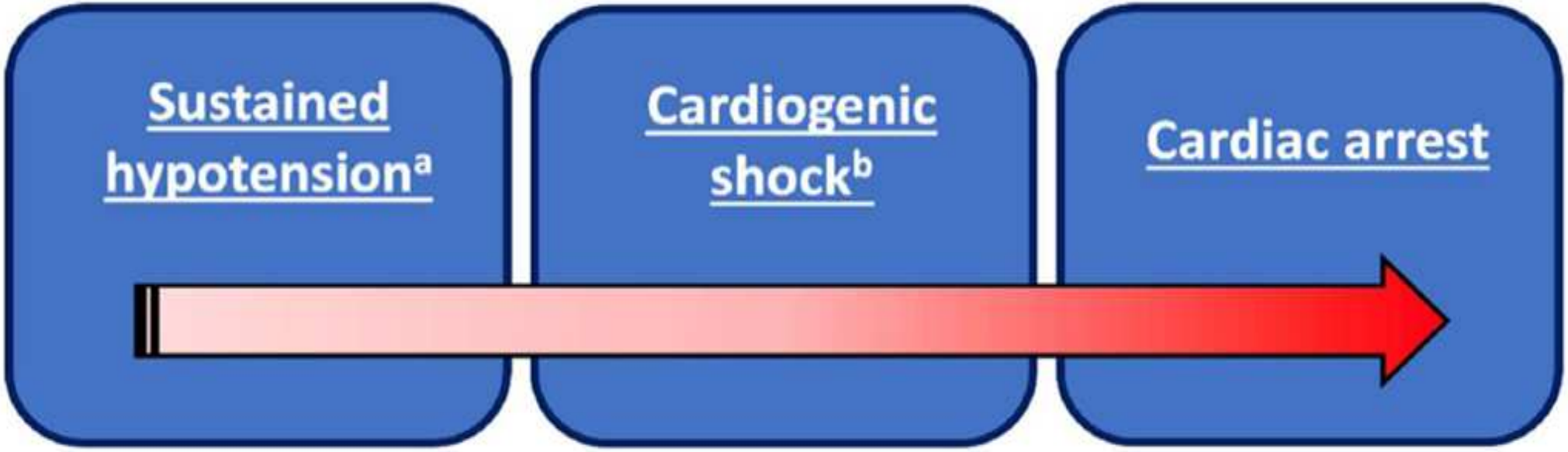
Risk-adjusted management strategy for acute PE

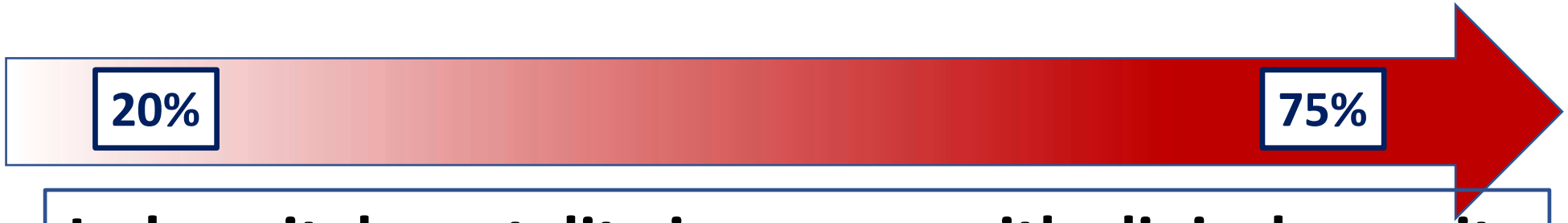


Konstantinides S et al. Guidelines ESC 2019, Eur Heart J 2019.

Les limites de cette stratification

High-risk PE : a wide spectrum of clinical conditions

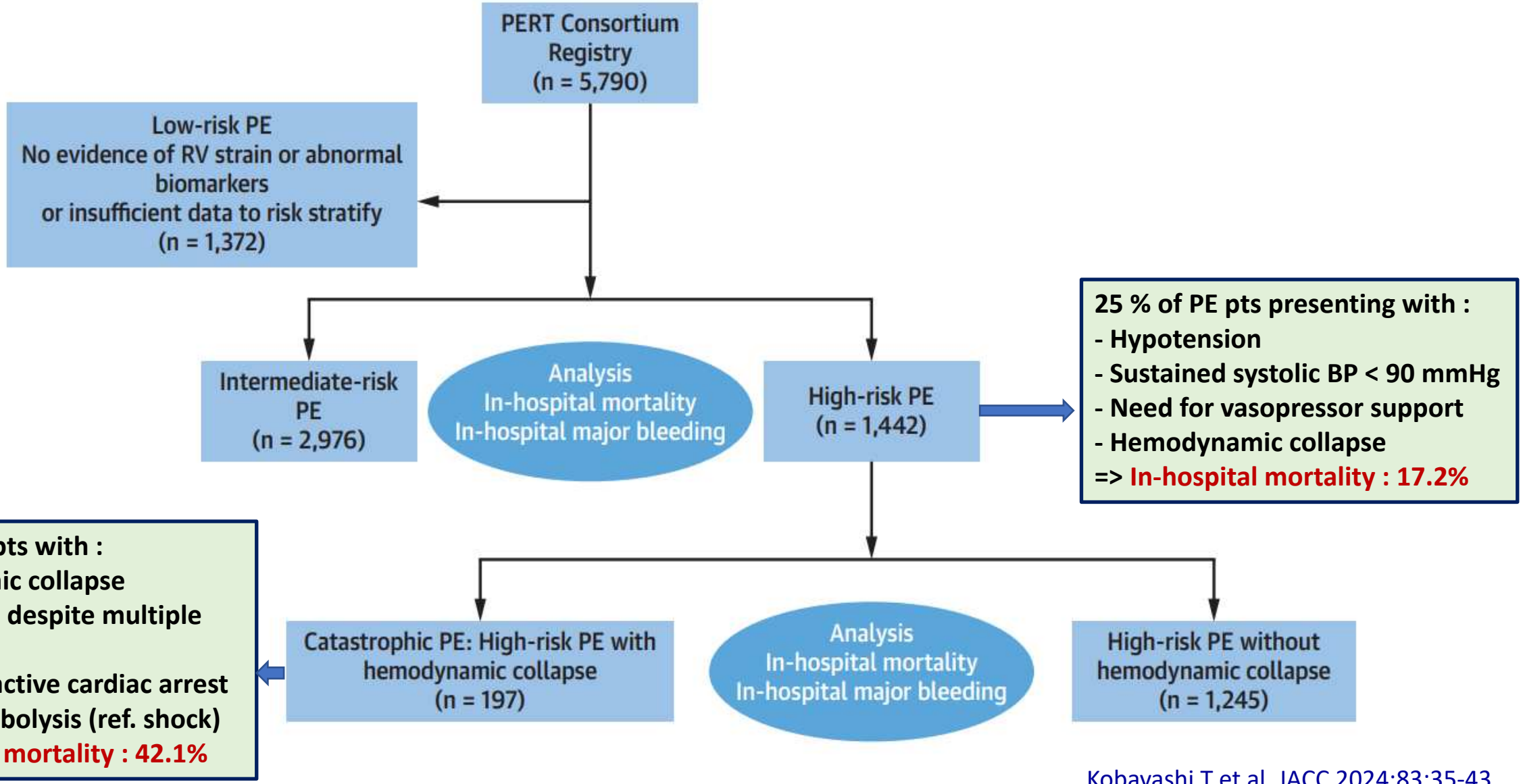




In-hospital mortality increases with clinical severity
30% mortality = average mortality

Chopard R, Meneveau N. J. Clin. Med. **2022**, 11, 4807. https://doi.org/10.3390/jcm11164807.

Outcomes of Pts with high-risk PE



Kobayashi T et al. JACC 2024;83:35-43.

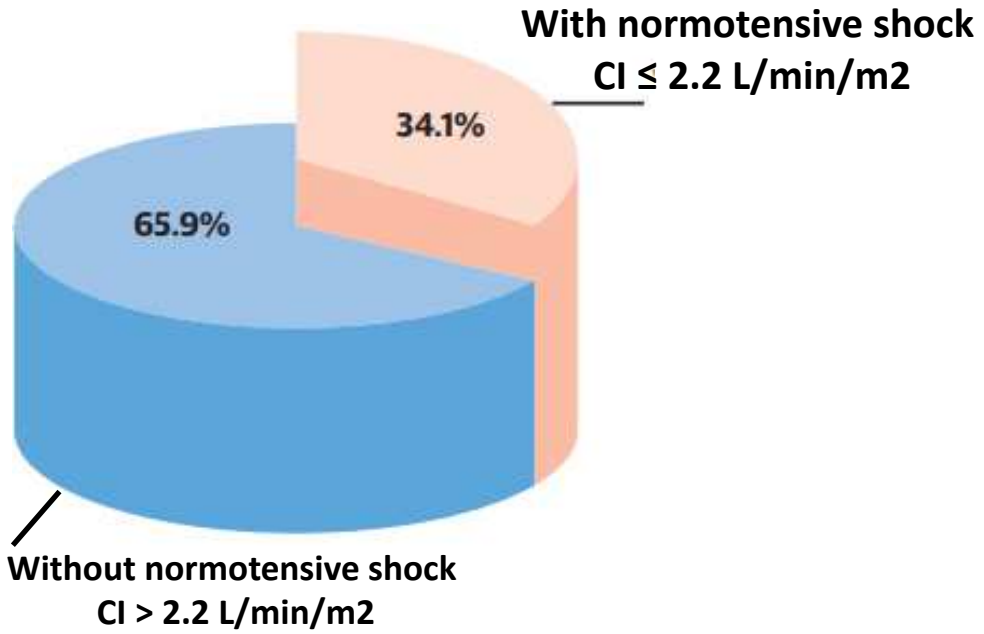
Intermediate-risk PE with normotensive shock

Normotensive shock in Pts with intermediate-risk PE from the FLASH registry

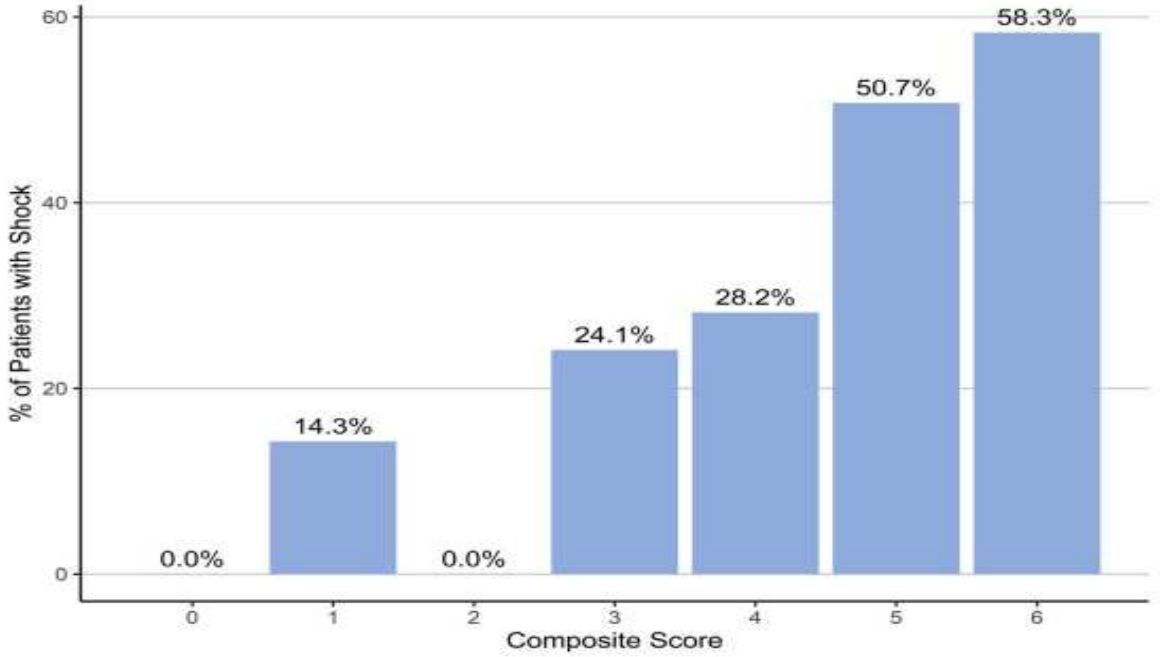
Composite Shock Score

Elevated Troponin + Elevated BNP + Moderate/Severely Reduced RV function + Saddle PE + Concomitant DVT + Tachycardia

Risk Factor Associated With Normotensive Shock
(OR: 5.84; 95% CI: 2.00-17.04)



Proportion of Pts with normotensive shock by Composite Shock Score



Bangalore S, et al. J Am Coll Cardiol Intv. 2023;16(8):958–972.

Parcours de soins dans l'EP => PERT (Pulmonary embolism response team)

Why is PERT activation needed in HR/IHR PE ?

PE : a clinical and logistic quandary

PEs mandate urgent intervention,

Multiple specialties may diagnose and treat PE (lack of consensus agreement),

PE treatment based on low level of evidence,

Increasing advanced therapeutic alternatives.

Rationale for PERT : rapid response system

Integrative multidisciplinary approach :

protocolized response to prevent CP arrest and death,

- identification of patients at risk,
- criteria to trigger the rapid response system,
- means to quickly notify and activate the response team.

Heart-team approach optimizing pt management & promoting "shared decision-making"

Dudzinski DM et al. Circulation. 2016;133:98-103.

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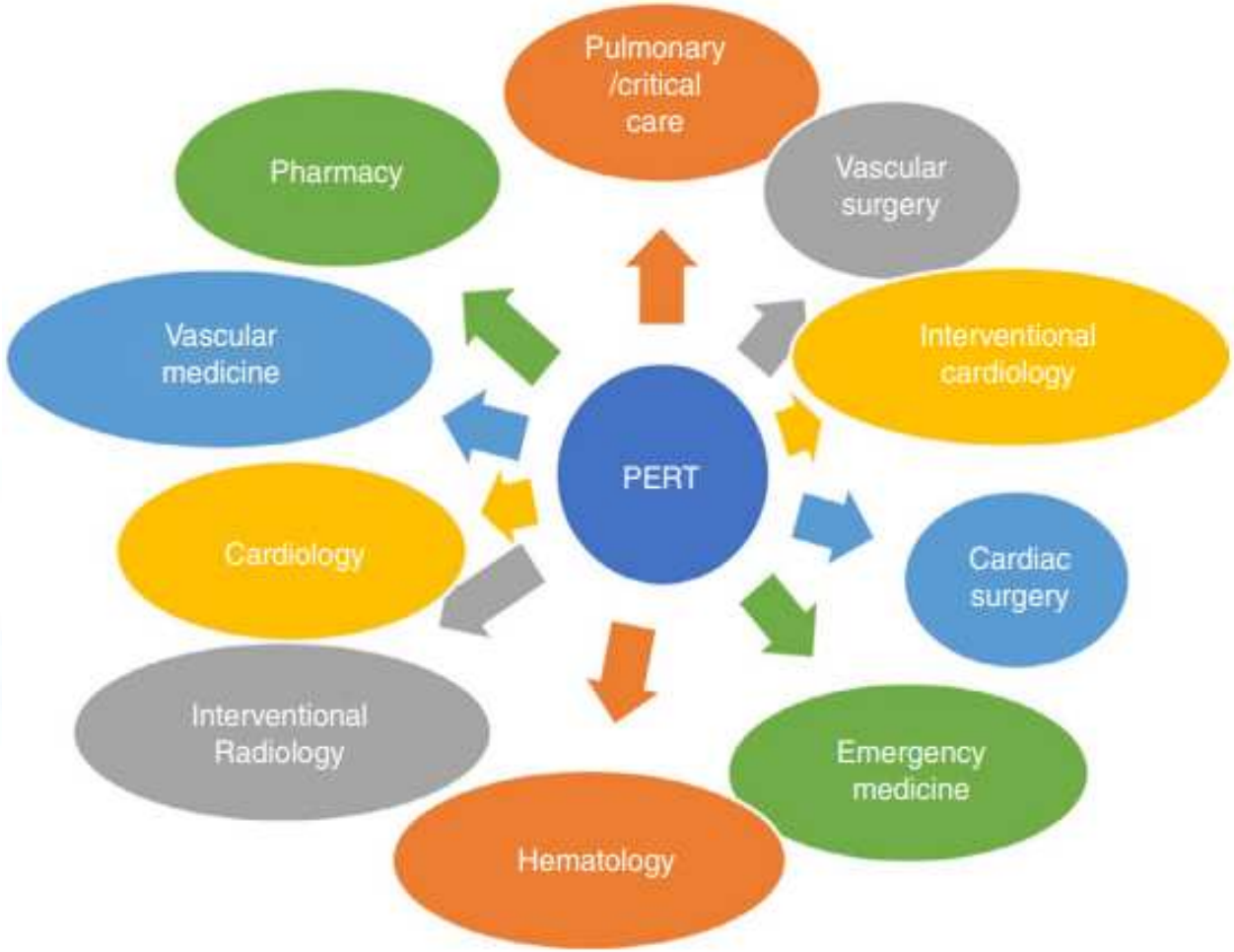
PERT implementation



Definition of PERT according PERT Consortium Guidelines

PERT = institutionally based multidisciplinary team that must meet the following criteria:

1. rapidly assess and provide TTT for pts with PE
2. full range of medical, surgical and endovascular therapies
3. appropriate FUP of pts
4. evaluate data regarding the effectiveness of TTT rendered

Activation with a single contact to a central call service => Conference call or virtual meeting

Rivera-Lebron B et al. Clin Appl Thromb Hemost 2019;25:1-16.
Rosovsky R et al. Res Pract Thromb Haemost. 2019;3:315–330.

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PERT and interhospital transfer of Pts with acute PE

Potential triggers for interhospital transfer

ideally discussed on individual case-by-case basis

TRIGGER FOR TRANSFER	EXAMPLES
Need for advanced therapies unavailable at referring center	• Contraindication to AC or systemic thrombolysis, and patient is a candidate for CDL or embolectomy • Refractory shock to medical therapy, and patient is a candidate for mechanical circulatory support
Need for higher level of care or closer monitoring than available at referring center	• Need for ICU level care either MICU or CV-ICU • Clinical worsening (e.g., worsening hypoxemia, tachycardia, hypotension) despite standard AC • Severe comorbidities (e.g., advanced heart or lung disease, peripheral vascular disease, chronic right ventricular failure, pregnancy) • Syncope and fall attributed to PE • High bleeding risk (e.g., elderly, prior stroke, recent major surgery, renal failure, history of major bleeding) • Active bleeding following thrombolysis • Hemodynamic decompensation despite adequate AC • Worsening acute right heart failure

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Rali P et al. CHEST 2021; 160(5):1844-1852.

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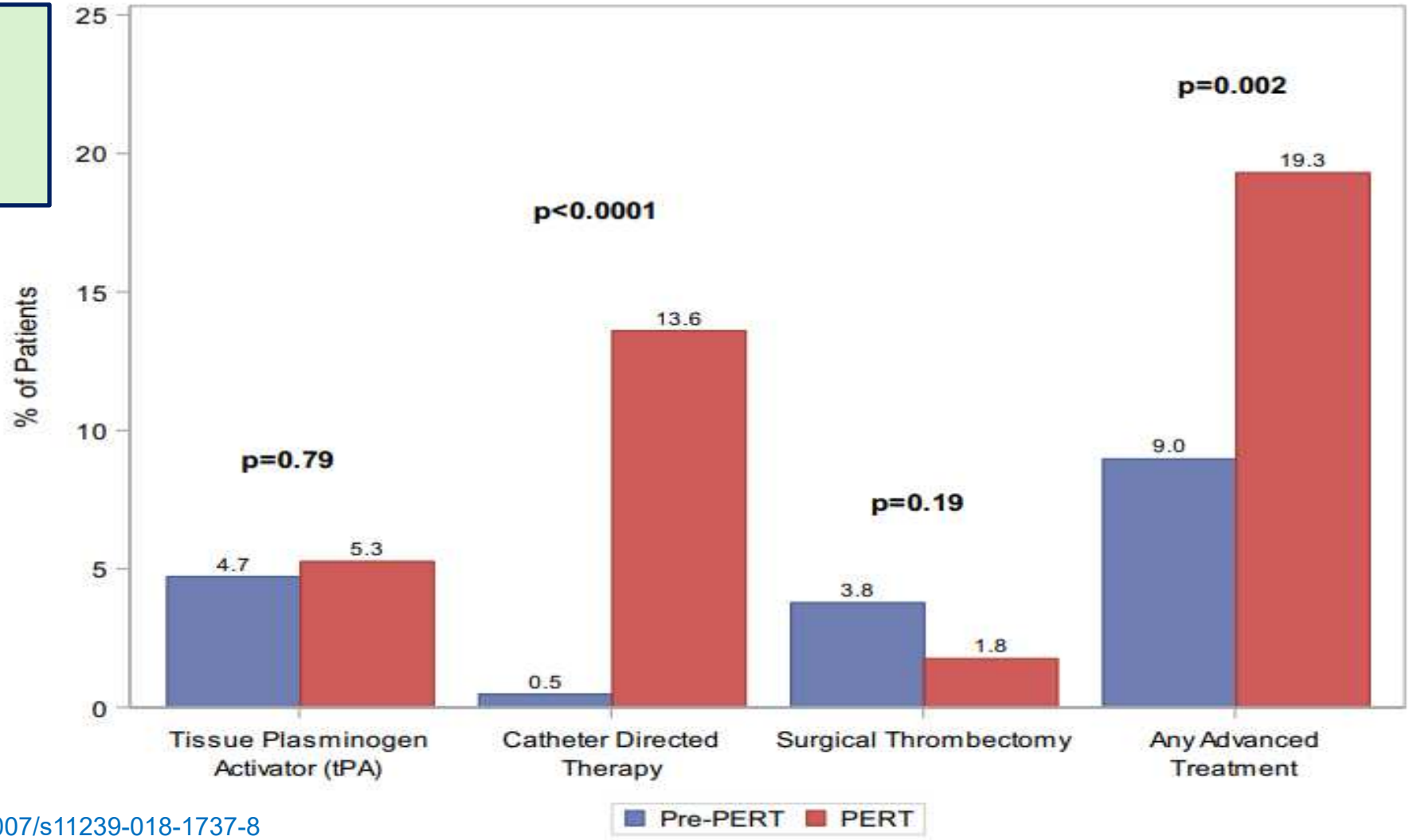
Changes in treatment after creation of a PERT : a 10-year analysis

Use of advanced treatments pre-PERT and post-PERT.

Implementation of a PERT increases the use of advanced therapies, especially CDT, for pts with high- & intermediate-high risk PE, with no associated change in bleeding or mortality

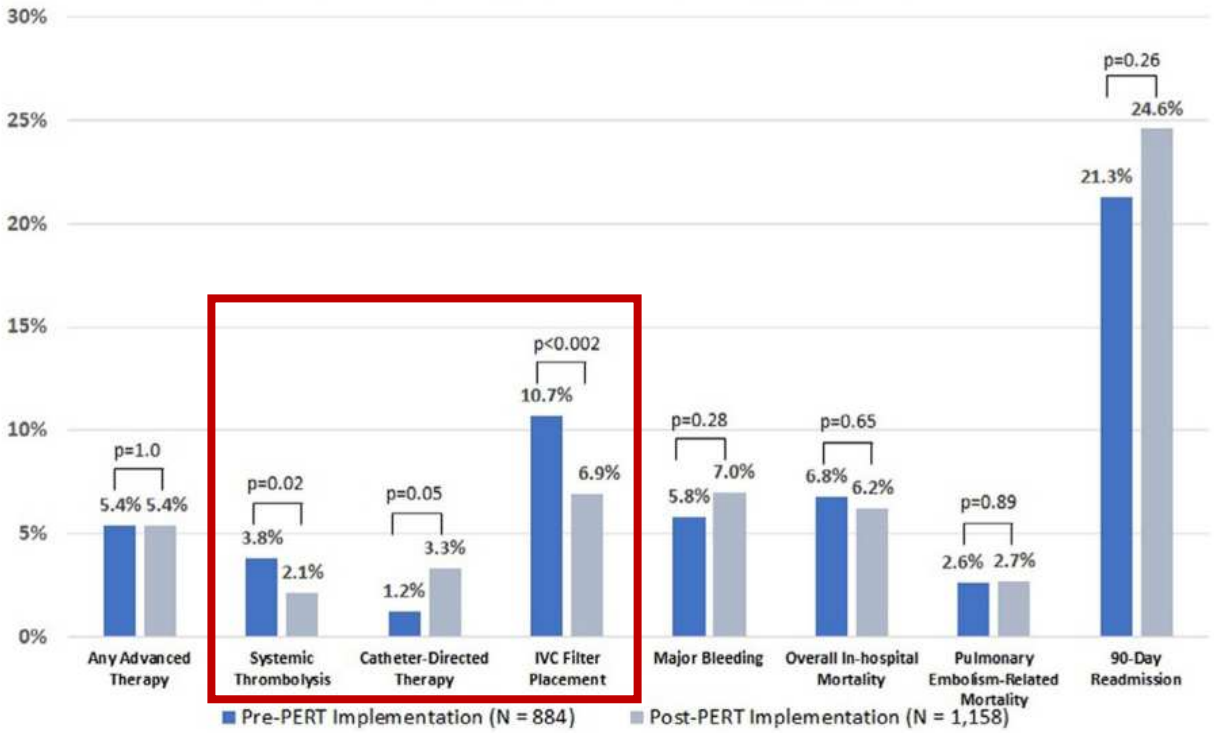


Rosovsky R et al. J Thromb Thrombolysis doi/10.1007/s11239-018-1737-8

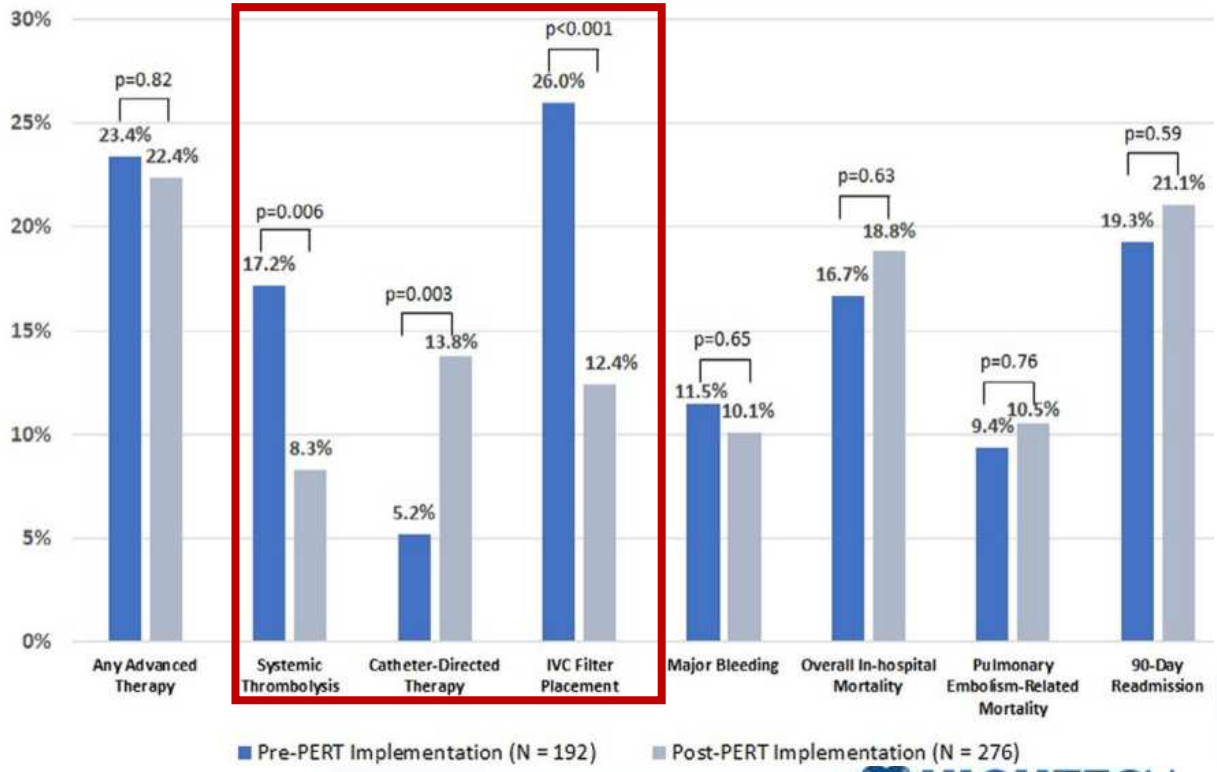
Changes in care for acute PE through a PERT

2042 pts with PE, 884 (41.3%) pre-PERT & 1158 (56.7%) post-PERT implementation

Outcomes in all pts with acute PE



Outcomes in elevated-risk pts with acute PE



Carroll BJ et al. Am J Med. 2020;133(11):1313–1321.

HIGHTECH

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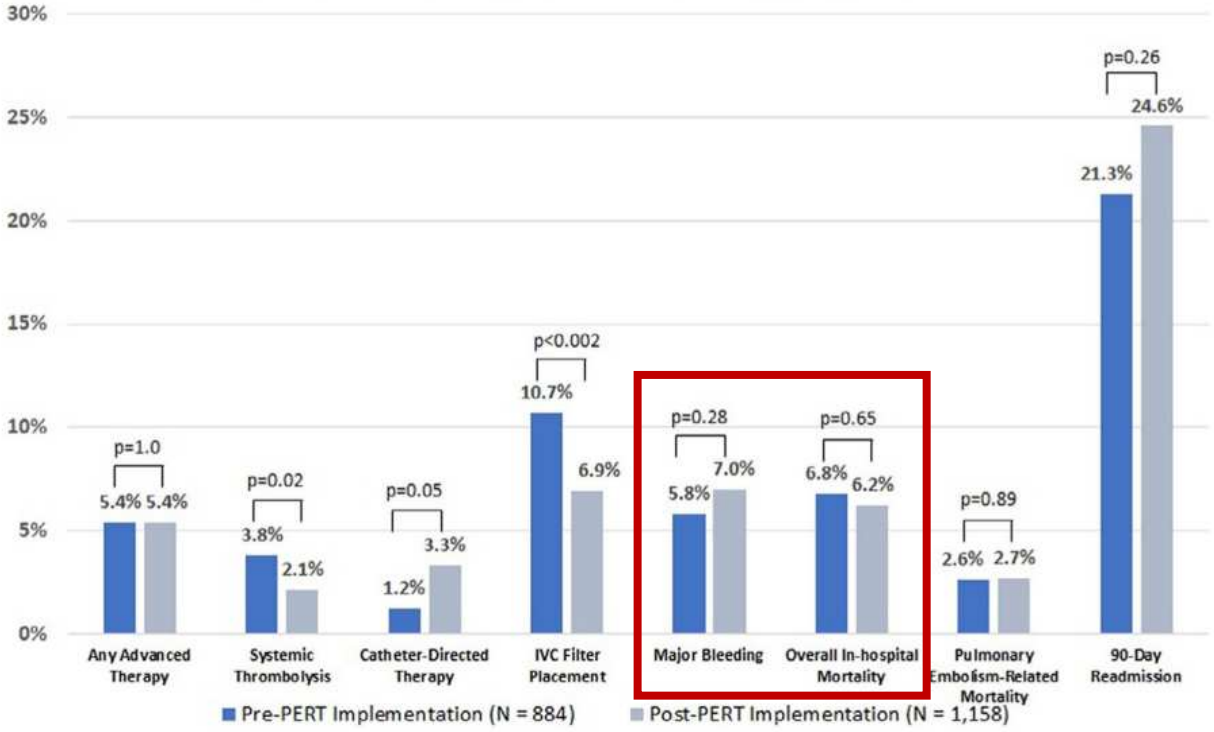

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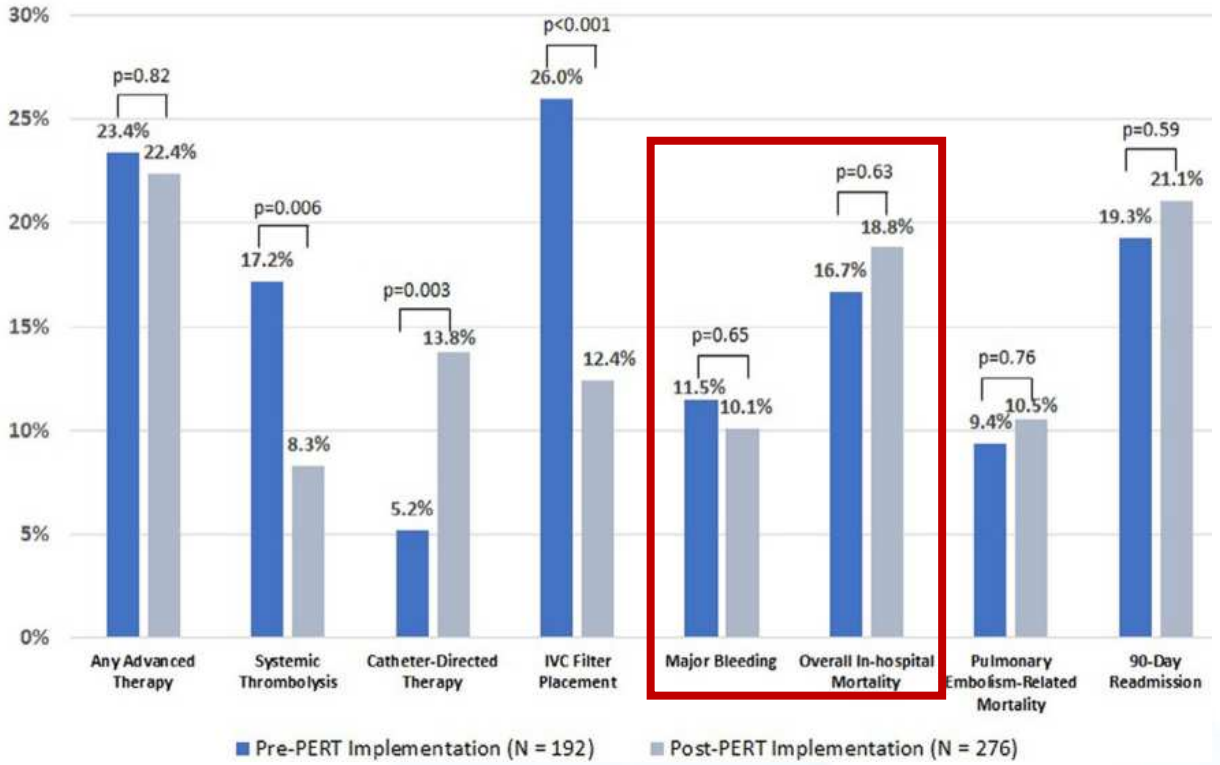

Carroll BJ et al. Am J Med. 2020;133(11):1313–1321.

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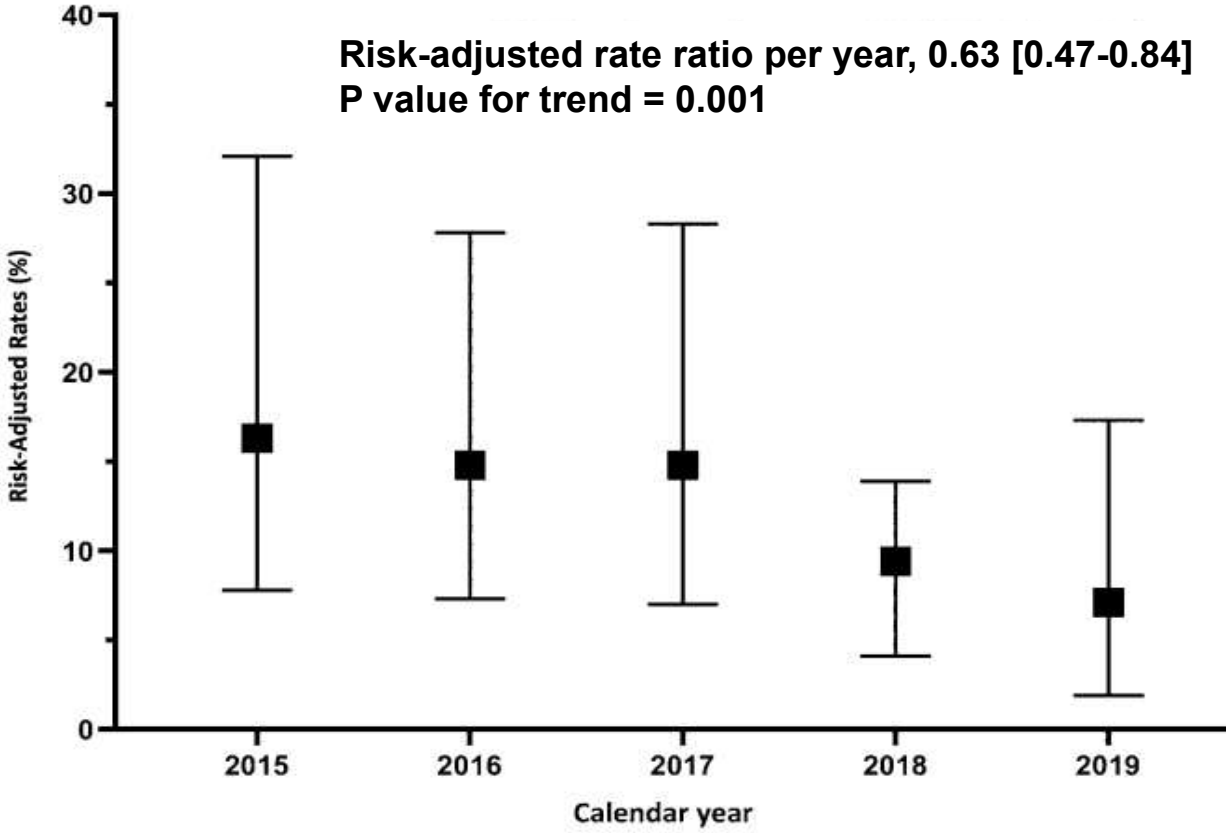
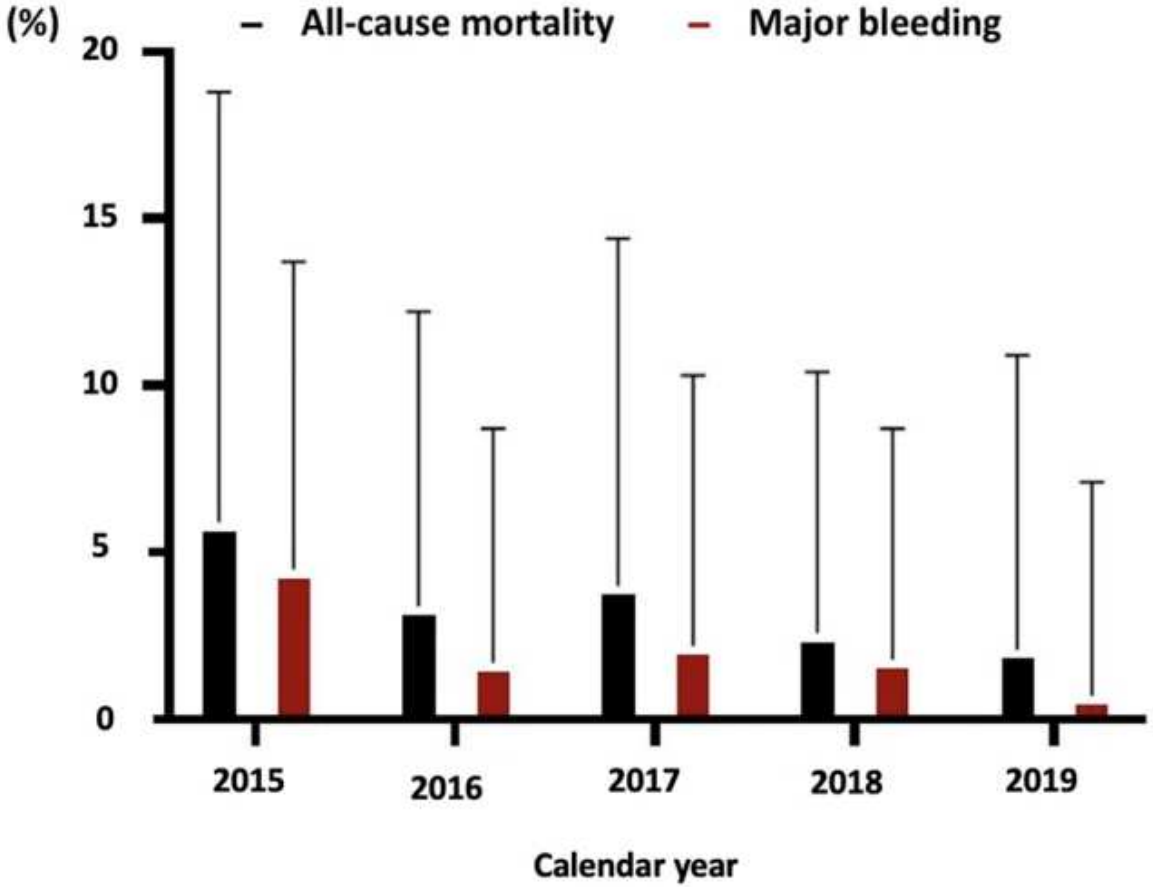
Temporal changes in PE outcomes following PERT implementation

425 pts with acute PE managed by the multidisciplinary PERT from 2015 to 2019





Adjusted temporal trends in composite outcomes at 30 days.

PE-related death, major bleeding, recurrent VTE, & rehospitalization

All-cause mortality : risk-adjusted rate 0.84 [0.58-1.21]; p=0.36 for trend

Major bleeding : risk-adjusted rate 0.61 [0.58-1.21]; p=0.04 for trend

Chopard R et al. J Thromb Thrombolysis https://doi.org/10.1007/s11239-022-02697-3.

HIGHTECH

Temporal changes in PE outcomes following PERT implementation

Trends in outcomes included in the primary composite end-point at 30 days and 6 months

Outcome	Risk-Adjusted Rates (%, 95%CI)*					Risk-Adjusted Rate ratio per year (95% CI)**	*p* value for trend**
	2015	2016	2017	2018	2019		
30 days							
Primary outcome	16.3 (7.8–32.1)	14.8 (7.3–27.8)	14.8 (7.0–28.3)	9.4 (4.1–13.9)	7.1 (1.9 (17.3)	0.63 (0.47–0.84)	0.001
All-cause death	9.2 (3.1–23.5)	4.4 (1.2–13.2)	5.3 (1.4–1.2)	2.2 (0.3–8.9)	1.9 (0.1–9.3)	0.73 (0.51–1.03)	0.07
Major bleeding	6.4 (2.1–18.5)	7.2 (2.6–17.3)	6.0 (1.8–16.3)	2.1 (0.3–8.3)	5.5 (1.4–15.5)	0.71 (0.52–0.96)	0.02
Recurrent VTE	1.4 (0.06–11.9)	1.5 (0.1–10.6)	0.6 (0.01–8.2)	0 (0–3.2)	0 (0–2.1)	0.50 (0.20–1.22)	0.12
Hospital readmission	18.6 (8.2–37.9)	10.3 (4.1–23.2)	11.3 (4.4–25.8)	6.3 (2.0–16.6)	4.0 (0.2–13.7)	0.78 (0.57–1.07)	0.12
6 months							
Primary outcome	15.8 (5.9–39.2)	14.5 (5.6–35.2)	15.7 (6.0–38.4)	10.1 (3.7–26.6)	9.5 (2.9–27.3)	0.37 (0.19–0.71)	0.02
All-cause death	14.6 (7.8–24.5)	11.4 (6.4–19.8)	15.2 (3.7–24.8)	12.5 (6.9–20.9)	8.2 (3.3–17.0)	0.57 (0.49–0.66)	<0.001
Major bleeding	11.3 (4.8–21.5)	12.3 (6.3–20.9)	11.0 (4.9–10.2)	3.2 (5.8–9.1)	11.2 (4.4–22.2)	1.0 (0.97–1.02)	0.84
Recurrent VTE	2.9 (0.4–10.4)	5.5 (1.8–12.5)	2.4 (0.3–8.8)	1.0 (0.02–5.8)	0 (0–4.6)	1.0 (0.02–5.6	0.63
Hospital readmission	19.2 (9.1–40.7)	12.4 (5.1–26.9)	12.6 (5.0–28.3)	6.7 (2.1–17.6)	6.5 (1.6–19.7)	0.80 (0.58–1.11)	0.19

Chopard R et al. J Thromb Thrombolysis https://doi.org/10.1007/s11239-022-02697-3.

A multidisciplinary pulmonary embolism response team (PERT) – first experience from a single center in Germany

Prospective single-center cohort study
2019 → 2022

PERT era:
Patients with confirmed PE with a PERT decision (n=88)

Pre-PERT era:
Matched patients without PERT before 2019 (n=88)

PERT activation from

- Emergency Unit (33.3%)
- ICU (30.0%)
- CPU (21.3%)

PERT composition

- Cardiology (100.0%)
- Cardiovascular surgery (98.6%)
- Radiology (95.9%)
- Anaesthesiology (87.8%)

Mortality:

PERT associated with lower all-cause mortality
(OR 37 [95%CI 0.15-0.84]; p=0.018),
but not PE-related death
(OR, 0.57 [95%CI 0.22-1.146; p=0.241)

Pre-PERT- vs. PERT-Population

All-cause mortality
(31.8% vs. 14.8%)

Severe bleeding complications
(13.8% vs. 1.1%)

Implementing PERT
⇒less systemic lysis or surgical embolectomy.
⇒reduced bleeding complications, and decreased all-cause and PE-related mortality.

Sagoschen I et al. Clinical Research in Cardiology (2024) 113:581–590.

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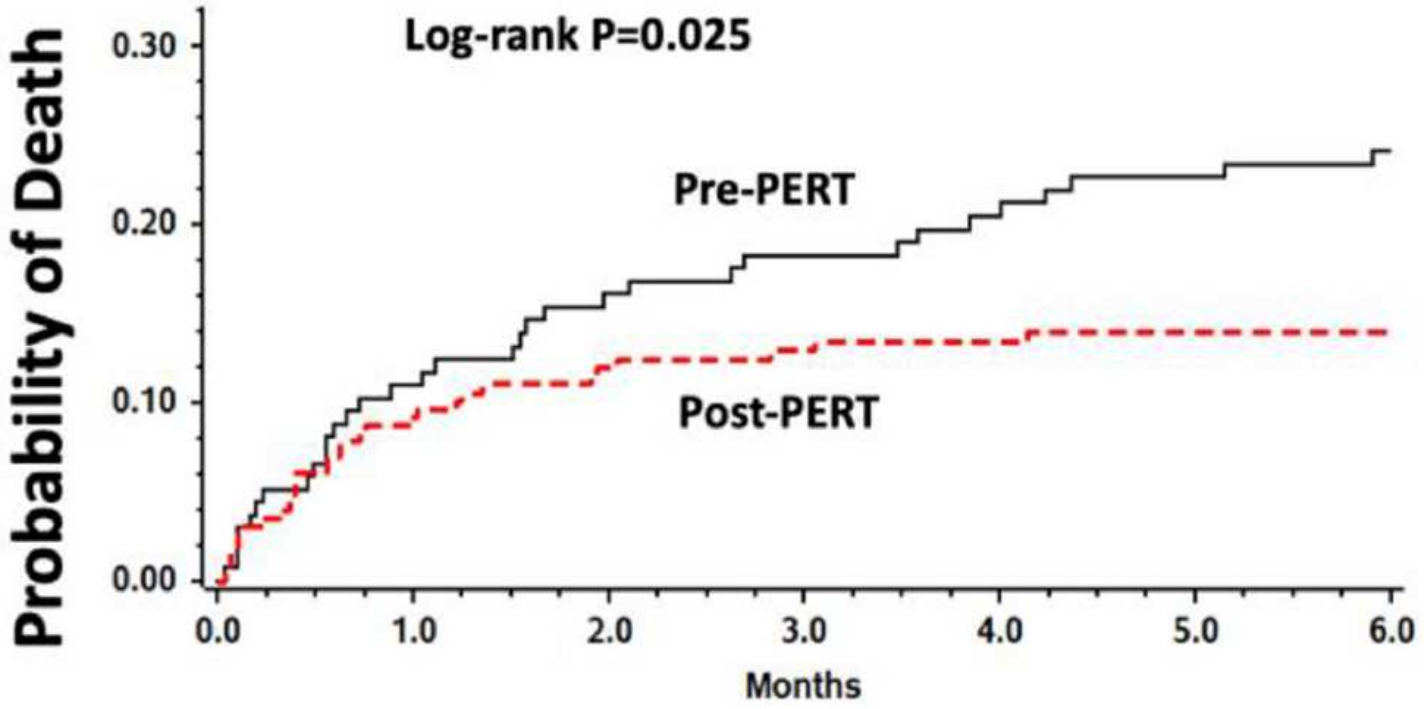
Impact of PERT in high-risk PE



Parameters	HR	95% CI		p-Value
Adjusted Mortality at 1 Month After PE Diagnosis	1.11	0.55	2.26	0.766
Adjust Mortality from 1 to 6 Months After PE Diagnosis	0.42	0.19	0.95	0.037

- Reduced length of stay following PERT implementation (9.1 vs. 6.5 days, P=0.007).
- **Time from triage to diagnosis of PE independently predictive of mortality, (reduced by 5% for each hour earlier the diagnosis was made)**

Wright C et al. Am J Cardiol. 2021;161:102–107.

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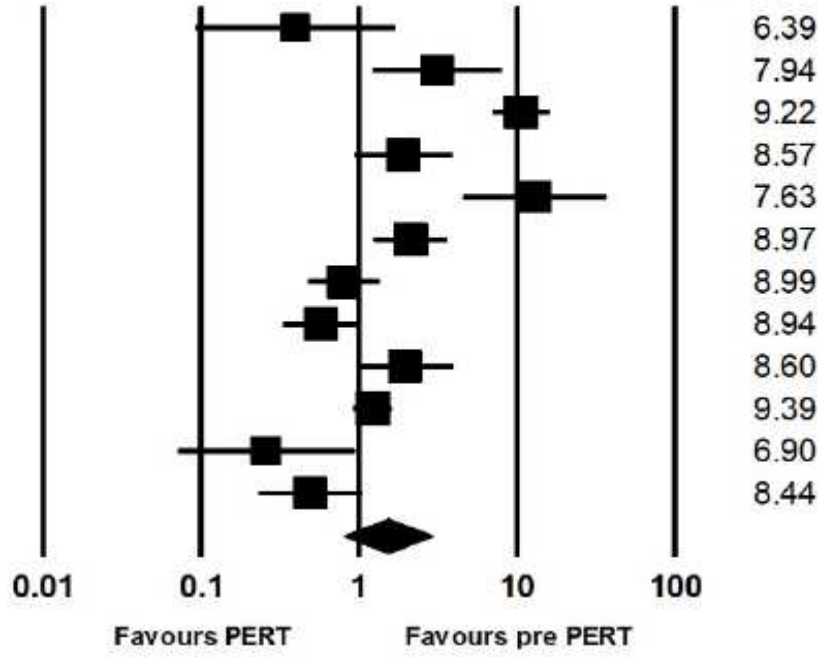
PERT - Evidence of benefits?
A systematic review and meta-analysis

13 observational studies, 12,586 pts, 60% pts from the pre-PERT period and 40% pts from the PERT period

All-cause mortality

Study name	Odds ratio	Lower limit	Upper limit	p-Value	PERT	Pre_PERT	Relative weight
2019 Chaudhury	0.39	0.09	1.70	0.211	2 / 57	29 / 343	6.39
2019 Rosovsky	3.12	1.22	7.97	0.017	19 / 228	6 / 212	7.94
2020 Carroll	10.63	7.10	15.93	0.000	72 / 165	60 / 884	9.22
2020 Jen	1.90	0.94	3.86	0.075	23 / 144	14 / 154	8.57
2020 Melamed	13.00	4.58	36.93	0.000	15 / 87	5 / 317	7.63
2020 Myc	2.12	1.24	3.62	0.006	33 / 120	36 / 237	8.97
2021 Annabathula	0.80	0.47	1.36	0.408	29 / 214	37 / 226	8.99
2021 Wright	0.57	0.33	0.99	0.048	32 / 231	30 / 137	8.94
2023 Ardeshna	1.96	0.98	3.92	0.058	24 / 156	14 / 168	8.60
2023 Hussein	1.22	0.92	1.62	0.167	64 / 819	284 / 4371	9.39
2024 Russell	0.26	0.07	0.93	0.039	3 / 133	12 / 146	6.90
2024 Sagoschen	0.49	0.23	1.04	0.065	13 / 88	23 / 88	8.44
Pooled	1.52	0.80	2.89	0.200			



Brian A et al. J. Clin. Med. 2024, 13, 7623. https://doi.org/10.3390/jcm13247623.

HIGHTECH

PERT - Evidence of benefits?
A scoping review and meta-analysis

22 original studies and 4 surveys

Literature search

- 26 studies
- Mostly from the US
- In total 9,823 patients with PE
- 9 studies with pre-PERT era as control arm

Patients with PE

- Mean age 60 years
- 48.7% females
- 23.5% malignancies
- 74.5% intermediate-risk PE
- 16% high-risk PE

PERT

- approx. 30% of patients with PE evaluated by PERT
- 6.5 specialties in average involved in PERT (range 2-10)
- cardiologists and surgeons included in all PERT cases

Outcomes

- Mortality
  RR 0.89 (0.67,1.19)
- Mortality in higher-risk PE
  RR 0.71 (0.45,1.12)
- length of hospital stay
  MD -1.6 days (-3.3,-0.3)
- Use of advanced therapies
  RR 2.7 (95% CI 1.3,5.5)

Hobohm L et al. Clinical Research in Cardiology (2023) 112:1351–1361.

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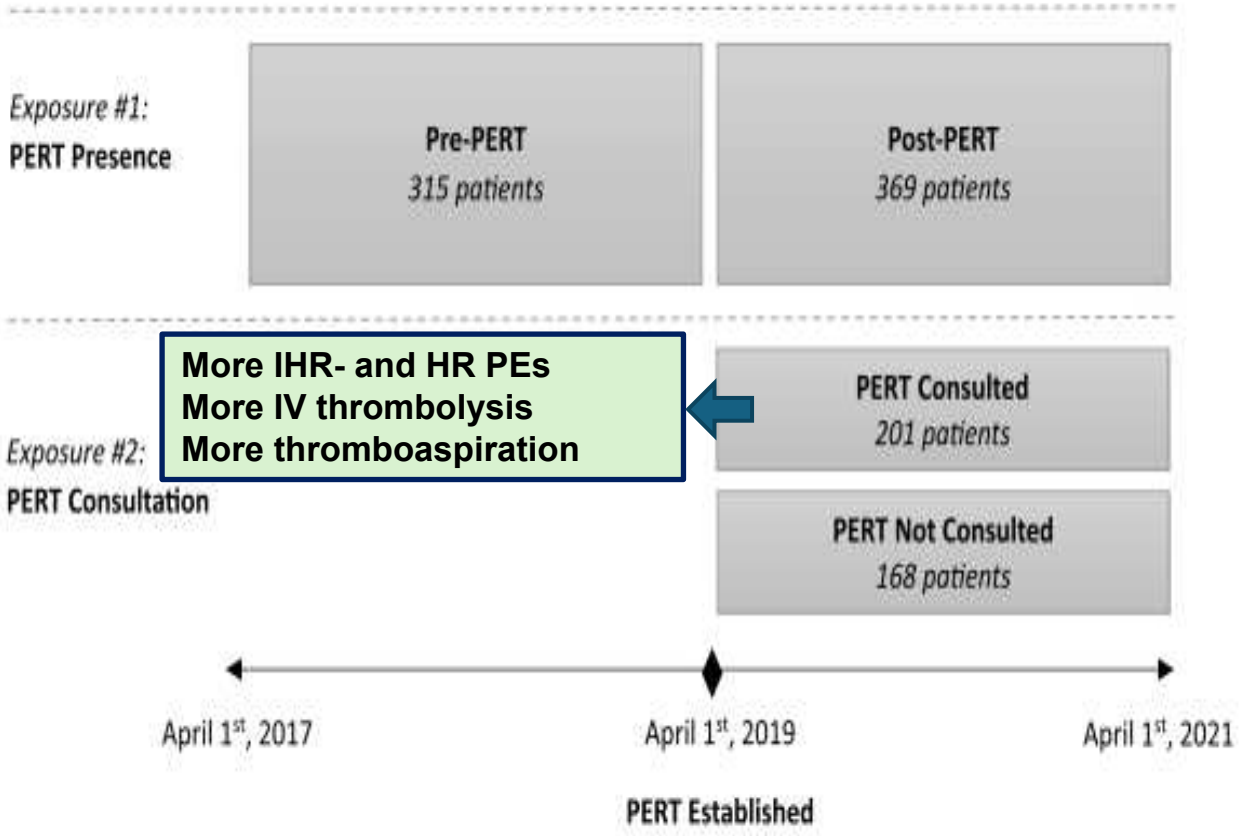
Reduced mortality is associated with PERT consultation not with the presence of PERT

Retrospective cohort study
(N=684; 315 pre-PERT pts & 367 post-PERT pts)



	PERT PRESENT	PERT CONSULTED
30 Day mortality		
Odds ratio	1.06	0.34
95% Confidence Interval	0.70, 0.162	0.18, 0.61
p-value	0.8	**<0.001***
Hospital length-of-stay		
Beta	-0.19	-5.4
95% CI	-2.5, 2.1	-8.2, -2.5
p-value	0.9	**<0.001***
Time to therapeutic anticoagulation		
Odds ratio	0.15	-0.25
95% CI	-0.03, 0.33	-0.49, -0.01
p-value	0.10	**0.041***
Active bleeding		
Odds ratio	0.99	0.28
95% CI	0.51, 1.90	0.09, 0.76
p-value	>0.9	**0.011***

Gardner TA et al. Thrombosis Journal (2024) 22:38.

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Take-home message

Parcours de soins de l'EP = mise en place d'un PERT

PERT concept = novel-team approach optimizing pt management & promoting "shared decision-making"

PERT theoretical advantages :

Input from a variety of clinicians

Improving timelines & coordination of care

Increasing access to advanced therapies when appropriate

Potential clinical benefits of PERT implementation remain to be established

Consultation of PERT, rather than the existence of PERT may benefit selected pts with acute intermediate or high-risk PE without a concomitant increase in advanced therapies.

Large prospective studies are needed further to explore the impact of PERTs on clinical outcomes.