An Introduction to the Win Ratio Method

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46th ANNUAL MEETING

May 18-21, 2025

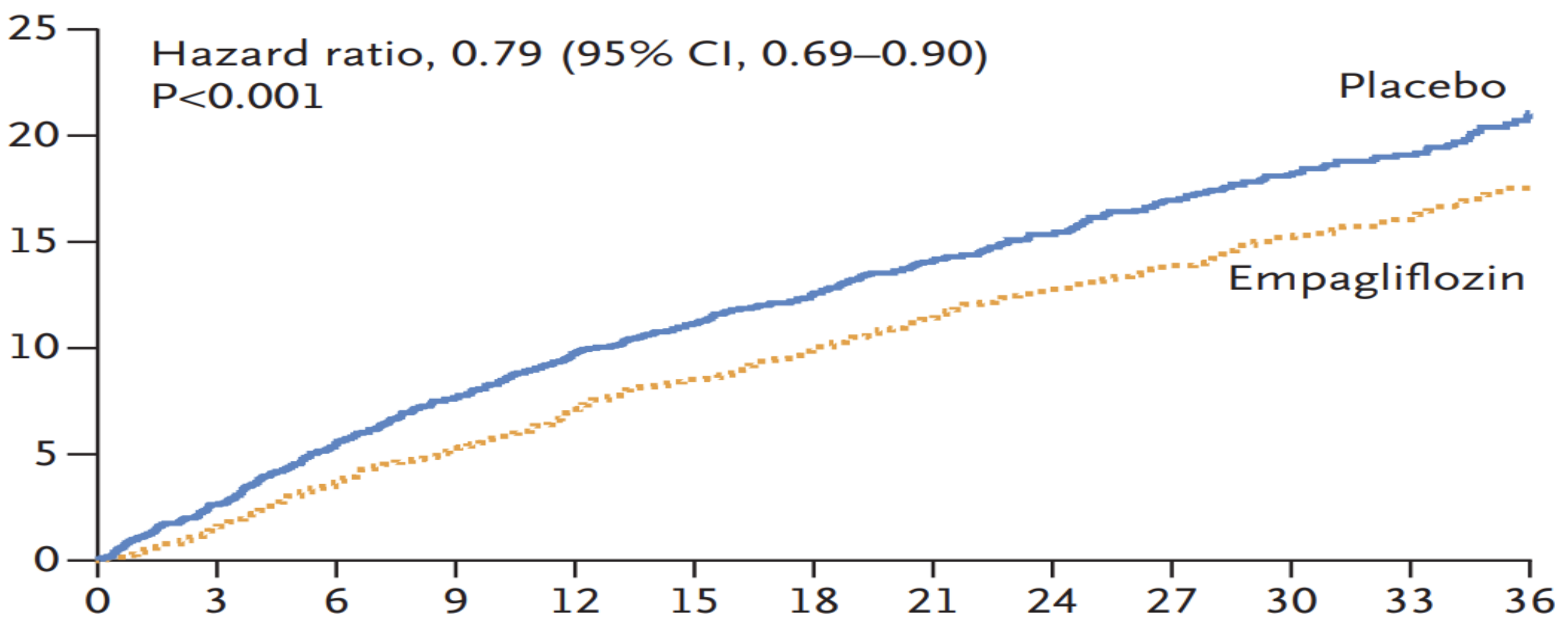
VANCOUVER
CANADA

SCT
SOCIETY FOR CLINICAL TRIALS

Disclosures

- None

Limitations of conventional composite endpoints



EMPEROR PRESERVED [NEJM 2021; 385 p1451]

EMPEROR PRESERVED [NEJM 2021; 385 p1451]

	Empagliflozin	Placebo
Primary composite	415	511
CV death	259	352
HF hospitalization	219	244
Total N of HF hosp	407	541

Time to first event analysis:

- Ignores 148 CV deaths that occur after HF hosp
- Ignores 337 repeat HF hospitalizations

EMPEROR PRESERVED [NEJM 2021; 385 p1451]

Endpoint	Hazard ratio	P-value
Primary composite outcome	0.79 (0.69 to 0.90)	<0.001
Cardiovascular death	0.91 (0.76 to 1.09)	
Hospitalization for HF	0.71 (0.60 to 0.83)	

Does not differentiate between the two components

Less important endpoint show strongest effect

No significant effect on CV death

Win ratio

- Advantages with the win ratio

1. Takes into account clinical priorities of different outcomes
2. Can incorporate different endpoint types

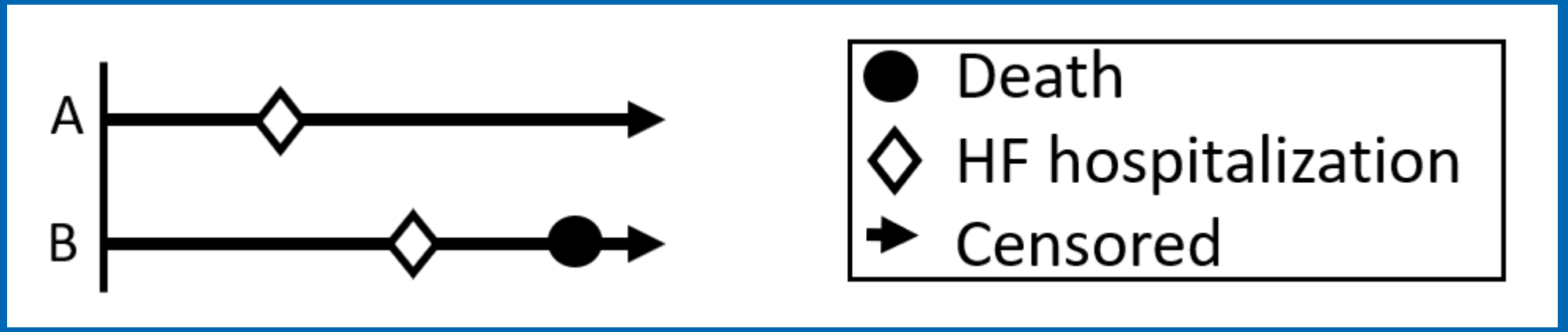
Win ratio – clinical priorities

- Define a hierarchy of outcomes based on clinical priorities
- Compare every patient in the treatment group with every patient in the control group
- Example with two levels:

  For each pair:
  - Who won on level one (typically death)?
  - If neither, who won on level two?
  - If neither, then they tie
- Win ratio = Number of wins in treatment arm / Number of wins in control arm

Win ratio – clinical priorities

For the composite of death and HF hospitalization

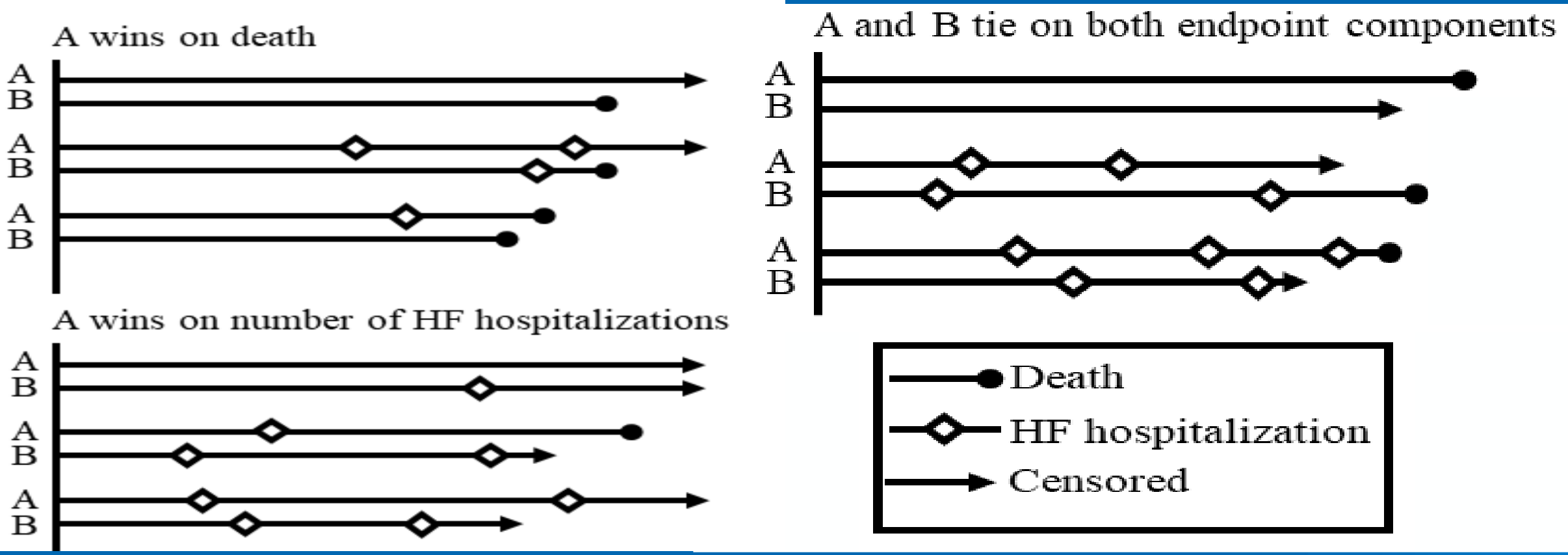


Time to first event analysis (conventional): The outcome for patient A is worse

Win ratio method: Patient A “wins”

Win ratio – clinical priorities

For the composite of death and HF hospitalization



Win ratio

- Advantages with the win ratio

1. Takes into account clinical priorities of different outcomes
2. Can incorporate different endpoint types

Win ratio – endpoint types

Conventional composite endpoint

- Time to first death or HF hospitalization (time-to-event)
- Occurrence of any death, HFH or reduction of 10 points in KCCQ at 1 year (binary)

Win ratio composite endpoint

- Time to first death (time to event), Number of HF hospitalization (count) and KCCQ at 1 year (continuous)

Win ratio – principles

Win ratio composite endpoint

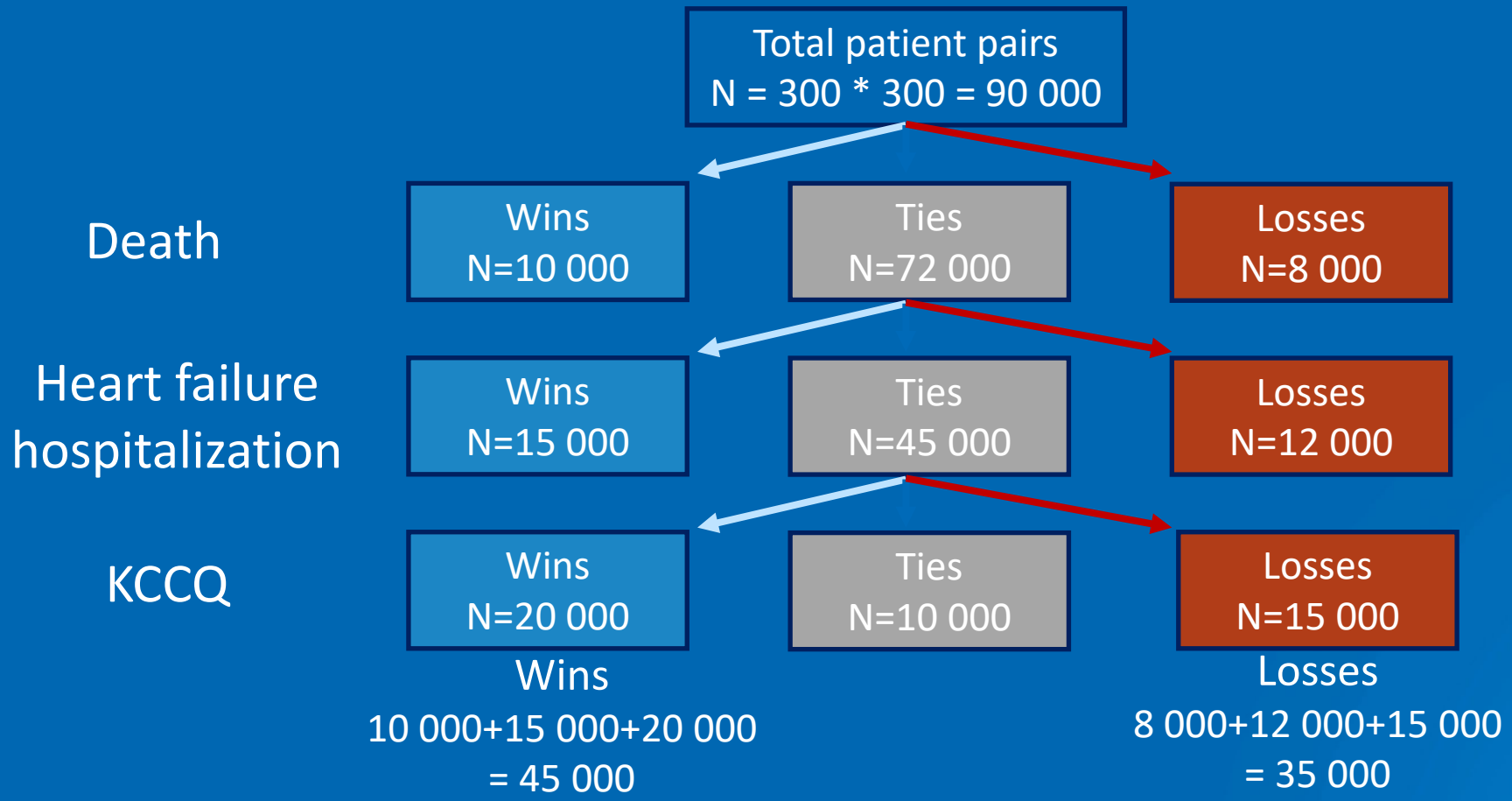
- Example with three levels:

For each pair:

- Who won on level one?
  - Did either of the patients die, and if so who died first?
- If neither, who won on level two?
  - Which of the patients was hospitalized the most times
- If neither, then who won on level three?
  - Which of the patients had the best KCCQ score at 1 year?
- If neither, then they tie

Win ratio – principles

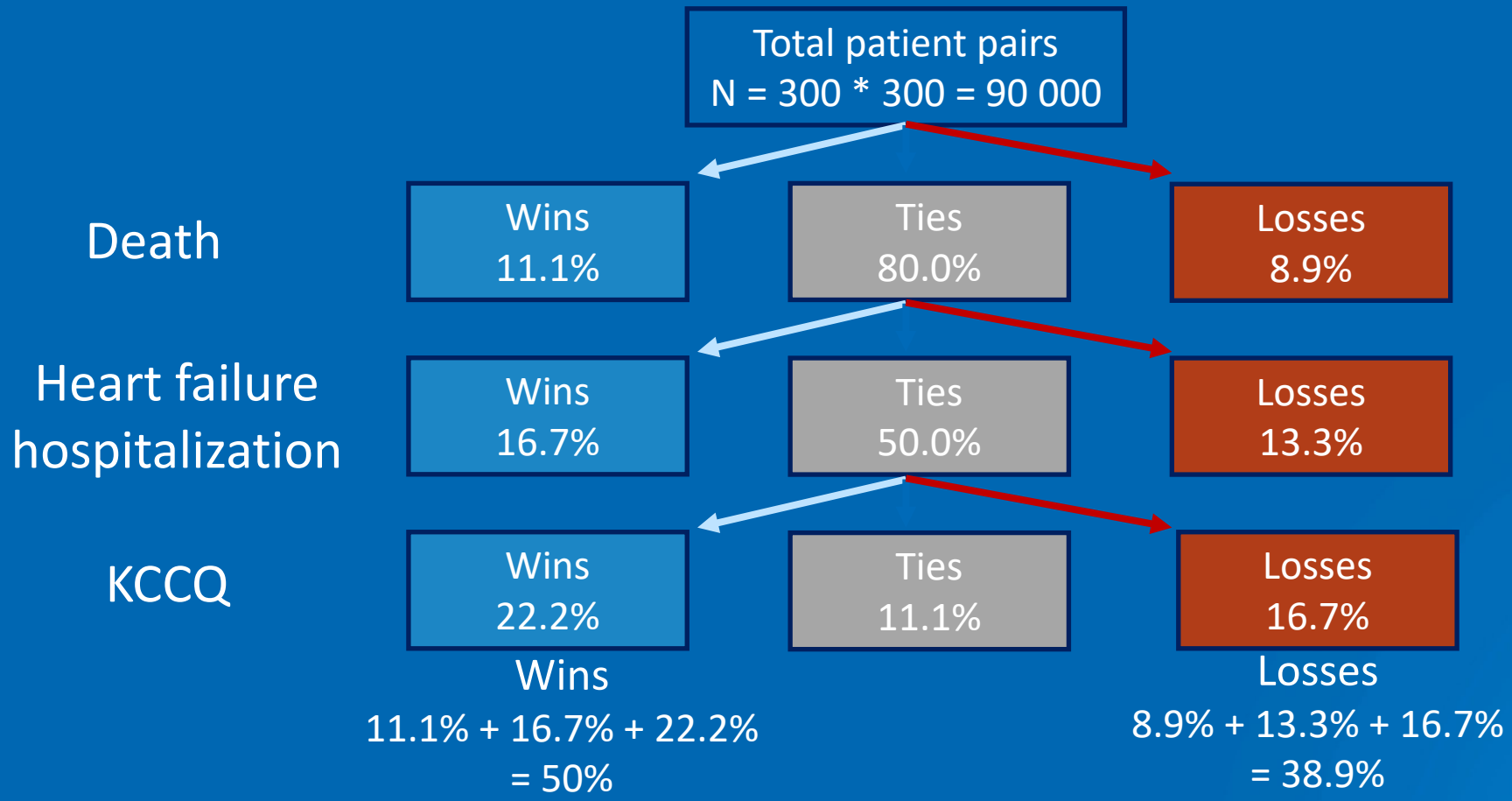
Consider a trial with 300 patients in each treatment arm



WR = 55 000 / 25 000 = 1.29

Win ratio – principles

Consider a trial with 300 patients in each treatment arm



WR = 50.0% / 38.9% = 1.29

Win ratio – interpretation

Interpretation:

- Win ratio: %wins / %losses

"If any two patients are compared, one from the treatment group and one from the control group, and they are not a tie, then the odds that the treatment patient is the winner is 1.29."

("In probabilities, the probability that the treatment patient wins is 1.29/(1.29 + 1)=0.56.")

- Win difference: %wins - %losses

"Net clinical benefit"

Novel matching extension and incorporating minimal clinically important differences in the Win Ratio

Madison Hyer

20th of May, 2025

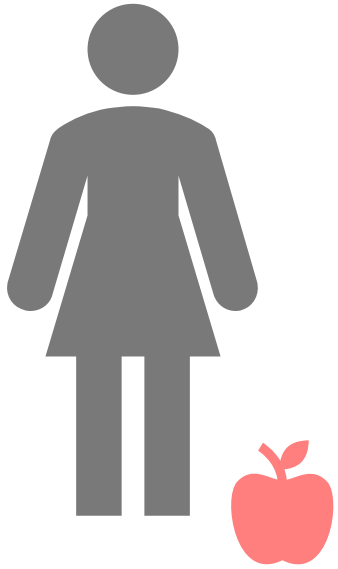
The Ohio State University
Wexner Medical Center

Disclosures

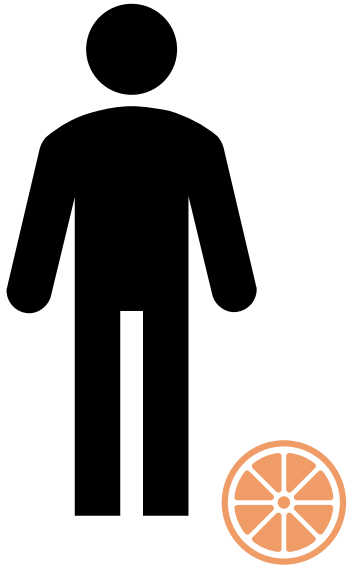
- No relevant disclosures

Meet...

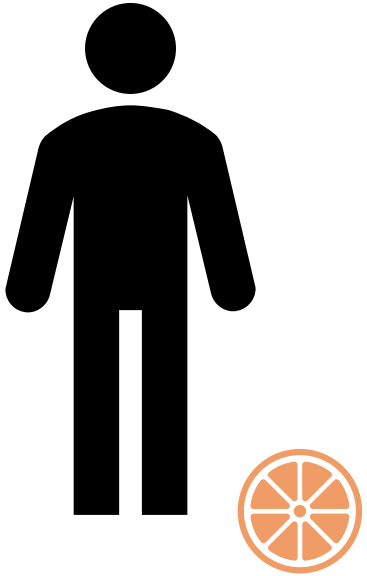
Alpha



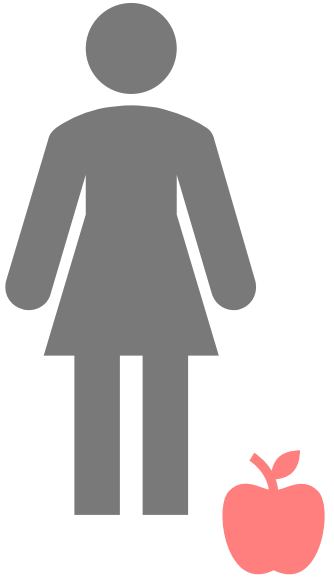
Charlie



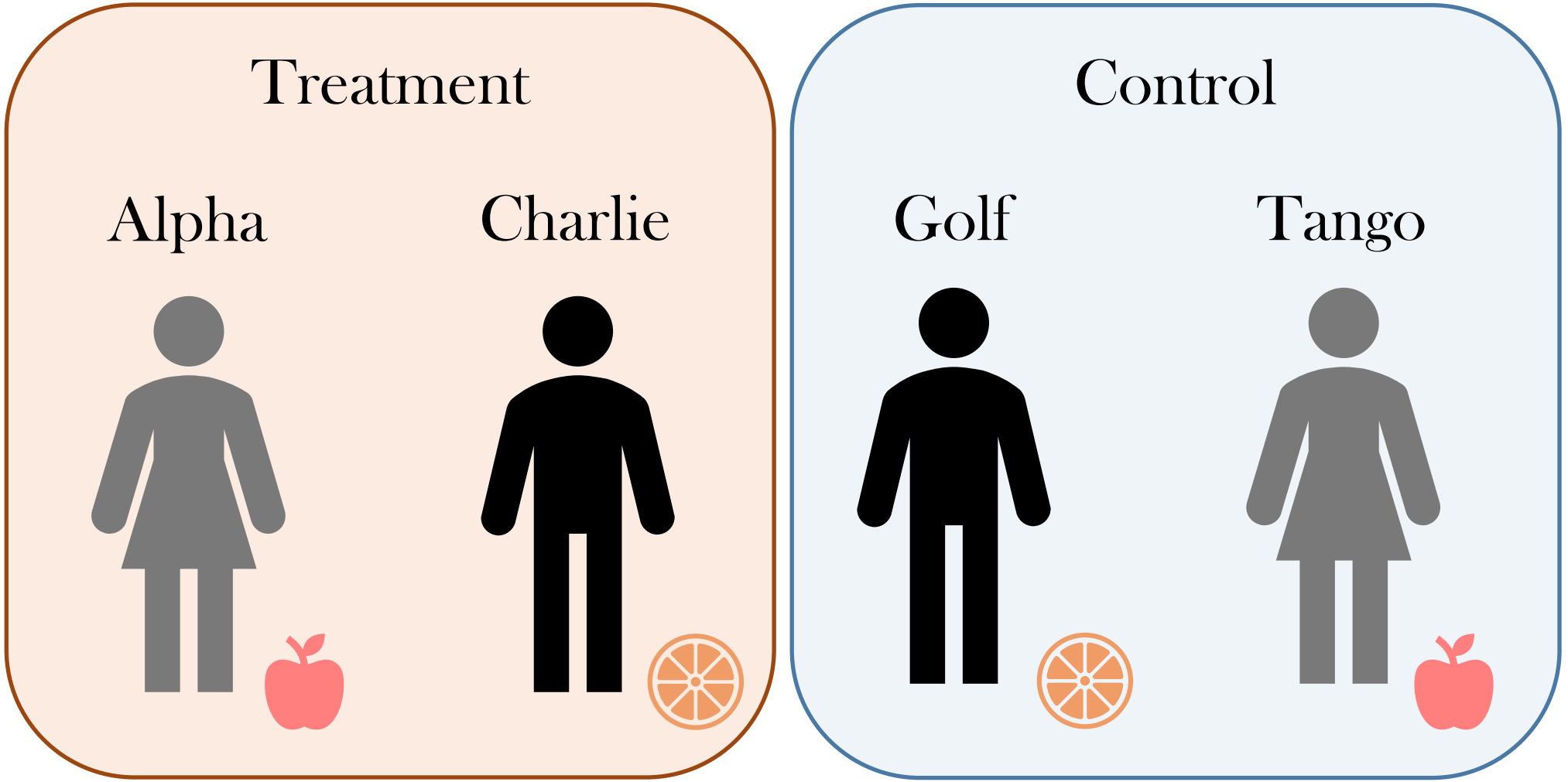
Golf



Tango



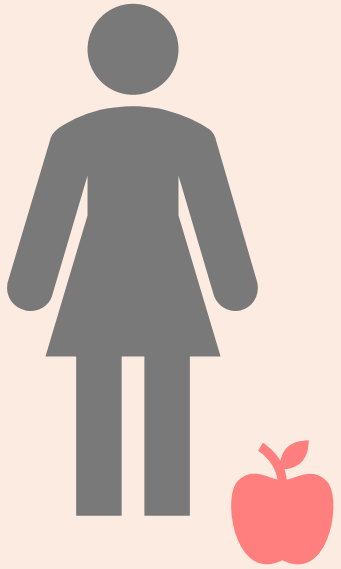
Let's see how they randomize...



Let's look at a single time–to-event outcome...

Event at 326 days

Alpha



Censored at 505 days

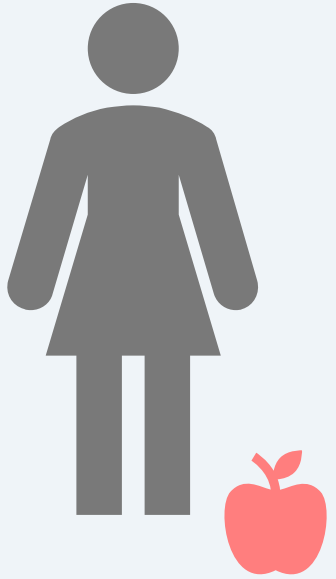
Charlie

Event at 414 days

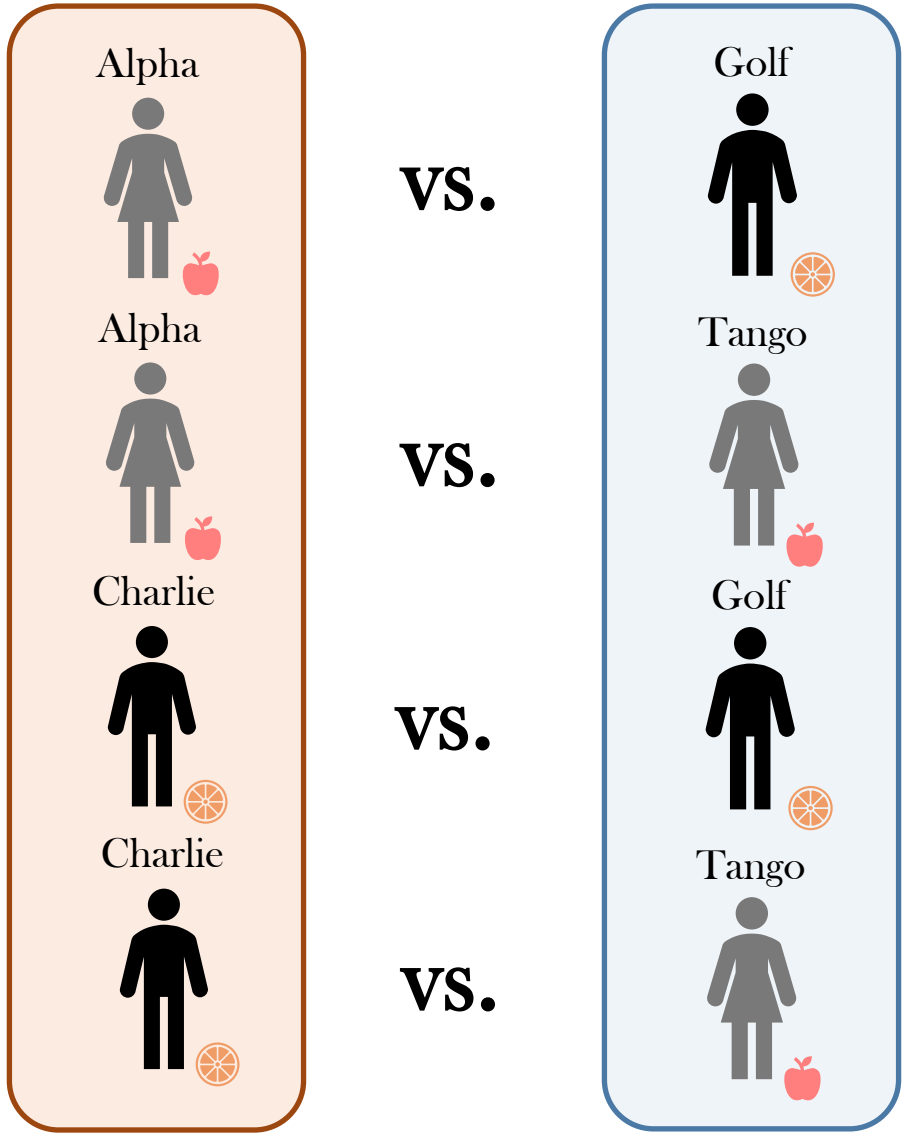
Golf

Censored at 327 days

Tango



Standard approach to WR



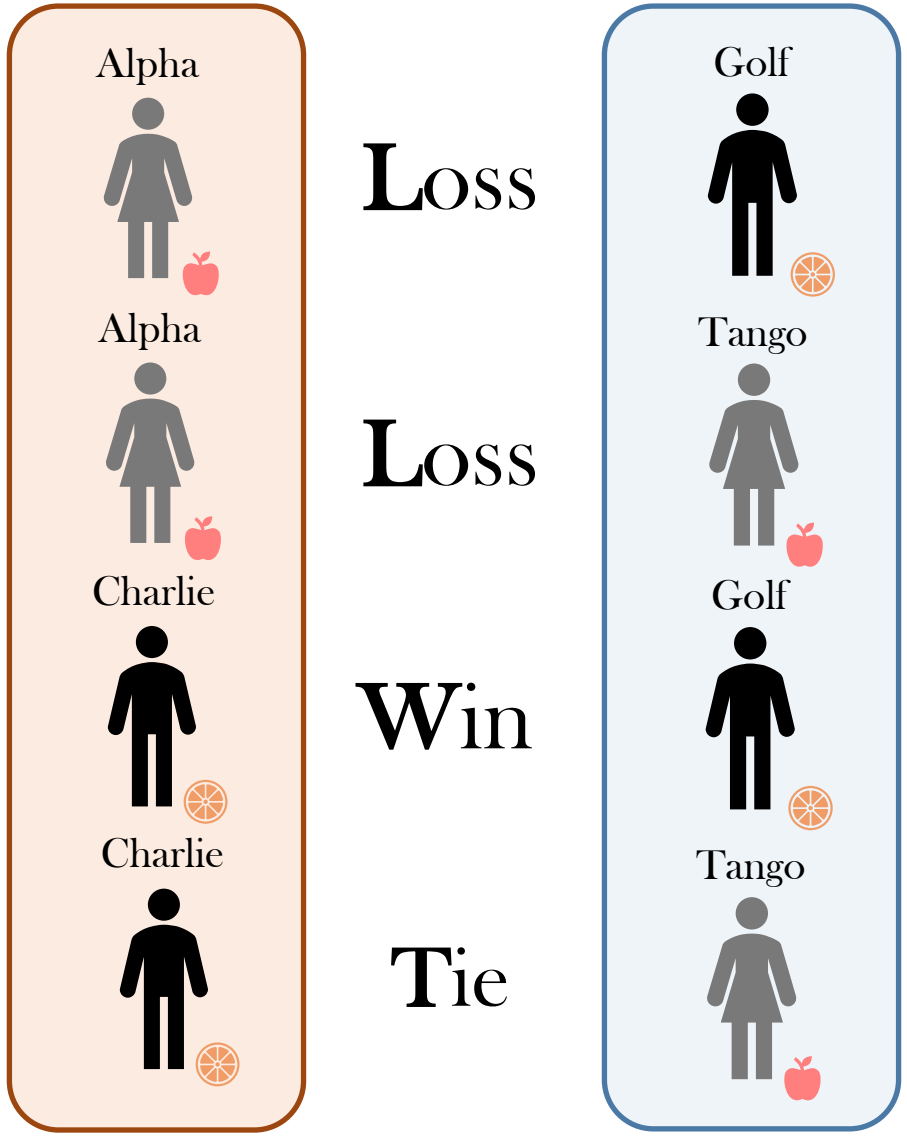
Event at 326 days **vs.** **Event** at 414 days

Event at 326 days **vs.** Censored at 327 days

Censored at 505 days **vs.** **Event** at 414 days

Censored at 505 days **vs.** Censored at 327 days

Standard approach to WR



Event at 326 days

Event at 326 days

Censored at 505 days

Censored at 505 days

Loss

Loss

Win

Tie

Event at 414 days

Censored at 327 days

Event at 414 days

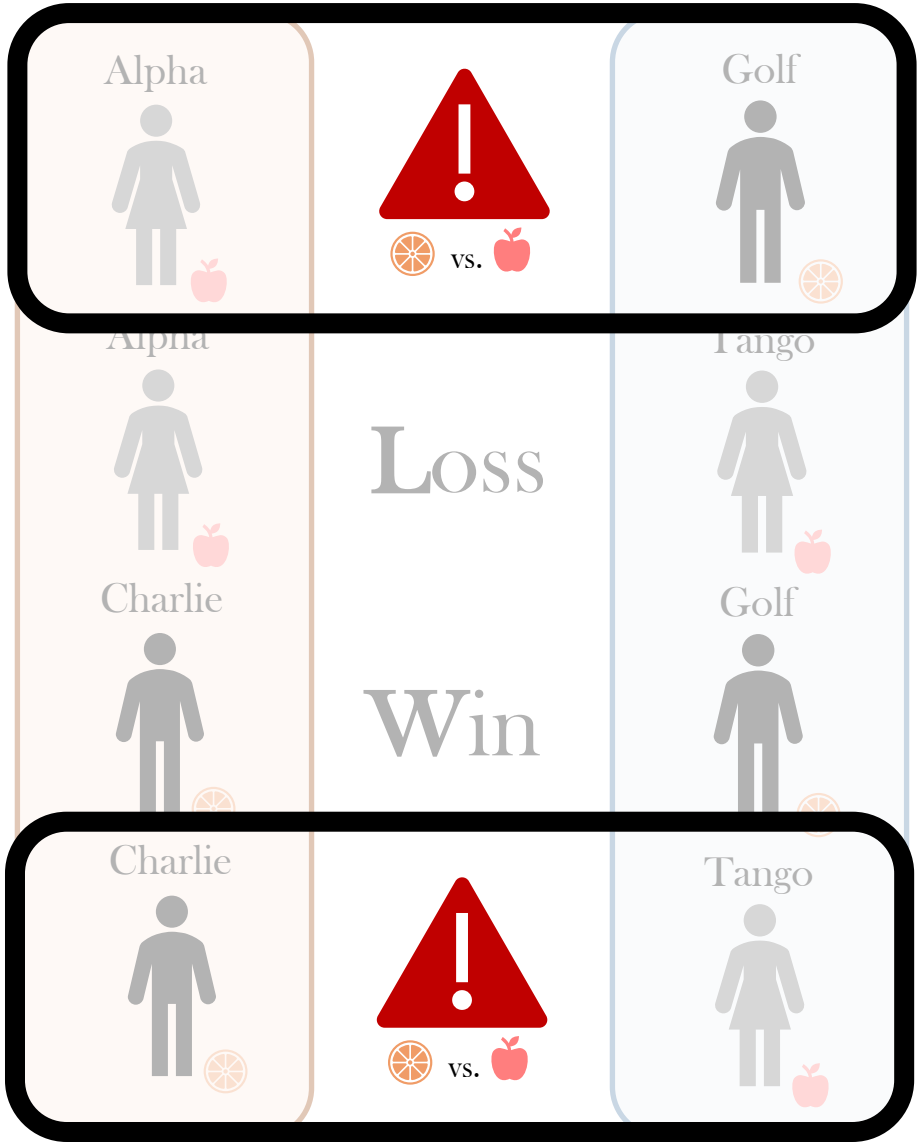
Censored at 327 days

Result

Original approach

- With more losses than wins, one would conclude that the intervention does more harm than good
    - Wins: 1
    - Losses: 2
    - Ties: 1

Fair comparisons?

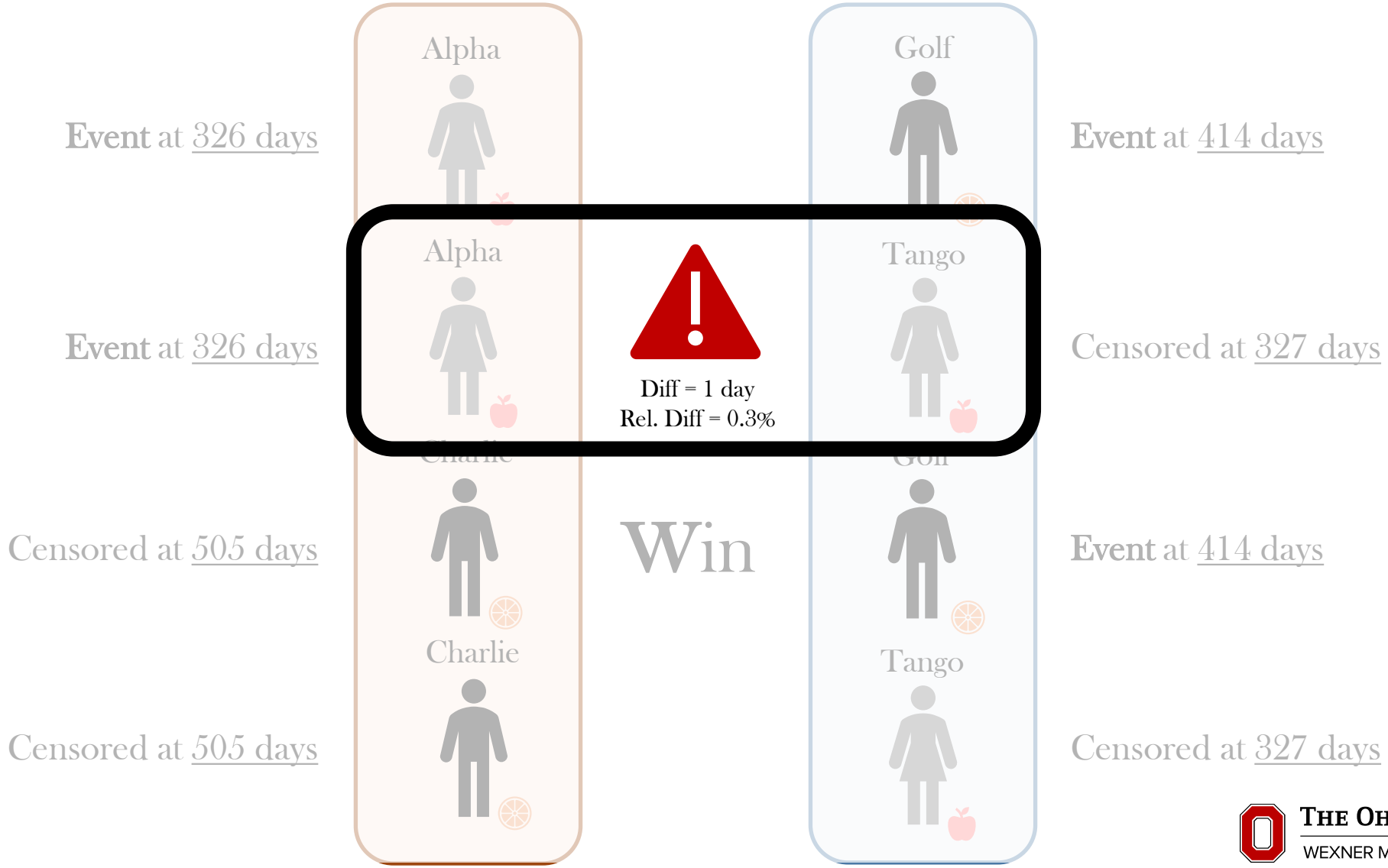


Result

After “controlling” for differences

- With equal wins and losses, one would conclude that the intervention has no effect
  - Wins: 1
  - Losses: 1
  - Ties: 0

Meaningful difference?



Result

After “controlling” for differences AND considering clinically meaningful differences

- With more wins than losses, one would conclude that the intervention has a positive effect
    - Wins: 1
    - Losses: 0
    - Ties: 1

Example Take-away

- In the absence of exceptionally narrow inclusion/exclusion criteria, the standard WR will inevitably compare “apples” and “oranges”

- The standard WR will inevitably classify “wins” and “losses” without considering clinical relevance of differences

Example Take-away

Disclaimer

- Though the results (status and time-to-event) were data from real patients in their 80s (apples) with patients in their 60s (oranges), the example is oversimplified for illustration
  - Often, there is more than one covariate of concern and they could be continuous

Considerations

- In practice, will you always see a more amplified effect in favor of the ”treatment” arm
    - No!

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  - No!
- While the directionality generally stays the same (in contrast with the example), the magnitude of the effect can be attenuated or amplified
  - *Generally*, the only thing that happens consistently is tighter confidence intervals

Considerations

- In practice, will you always see a more amplified effect in favor of the ”treatment” arm
  - No!
- While the directionality generally stays the same (in contrast with the example), the magnitude of the effect can be attenuated or amplified
  - *Generally*, the only thing that happens consistently is tighter confidence intervals
    - **NOTE**: One could “overcorrect”, matching on too many things and thus, dramatically reduce number of pairs which could inflate confidence intervals

Limitations

- While the incorporation of a minimal clinical important difference could be incorporated into simulations for power analyses, matching is often not possible to include in power analysis simulations

- Confidence intervals need to be calculated via bootstrapping

Win Ratio implementation in WINDSURFER trial

Lai Wei, PhD

May 20th, 2025

Disclosures

- No relevant disclosures

WIN ratio analysis to Determine a strategy of non-invasive SUpport for Respiratory Failure in the EmeRgency Department trial (WINDSURFER)

- Two comparators
  - High flow nasal oxygen (HFNO)
  - Non-invasive positive pressure ventilation (NIPPV)

WIN ratio analysis to Determine a strategy of non-invasive SUpport for Respiratory Failure in the EmeRgency Department trial (WINDSURFER)

European Heart Journal (2012) **33**, 176–182
doi:10.1093/eurheartj/ehr352

SPECIAL ARTICLE

The win ratio: a new a of composite endpoint on clinical priorities

Stuart J. Pocock*, Cono A. Ariti, Timo

Department of Medical Statistics, London School of Hygiene and Tropical Medici

Received 13 June 2011; revised 16 July 2011; accepted 15 August 2011; online publis

ESC European Society of Cardiology

European Heart Journal (2020) **41**, 4391–4399
doi:10.1093/eurheartj/ehaa665

CLINICAL REVIEW
Ischaemic Heart Disease

The win ratio approach for composite endpoints: practical guidance based on previous experience

Björn Redfors [1,2,3], John Gregson [4], Aaron Crowley [1], Thomas McAndrew [1], Ori Ben-Yehuda[1,2], Gregg W. Stone [1,5], and Stuart J. Pocock[4]*

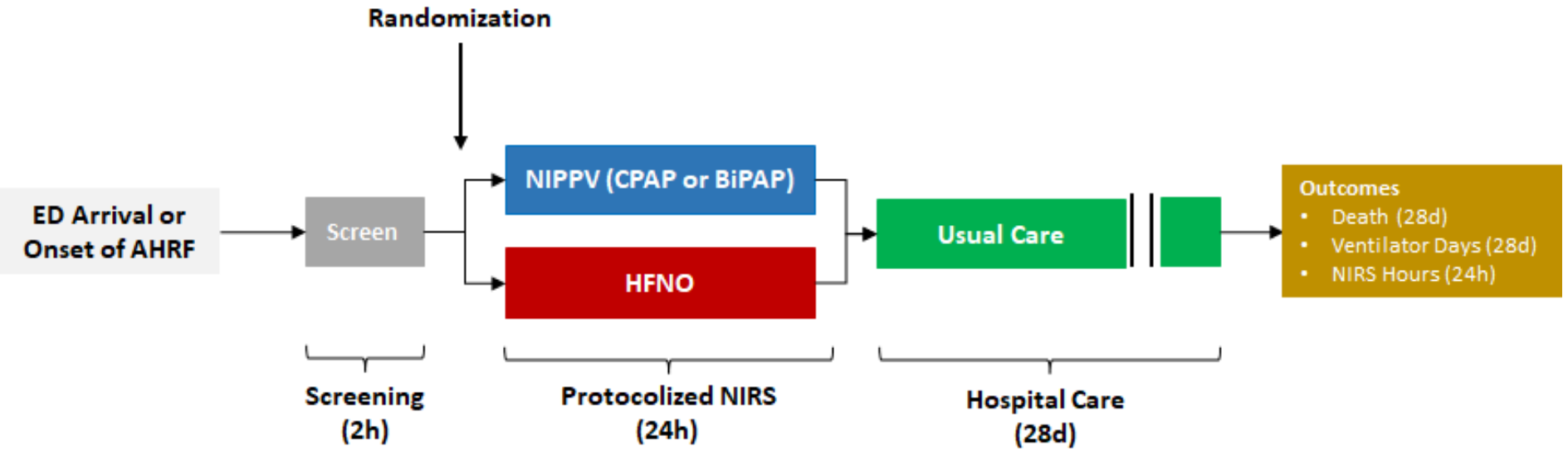
[1]Clinical Trials Center, Cardiovascular Research Foundation, New York, NY, USA; [2]Division of Cardiology, NewYork-Presbyterian Hospital/Columbia University Irving Medical Center, New York, NY, USA; [3]Department of Cardiology, Sahlgrenska University Hospital, Gothenburg, Sweden; [4]Department of Medical Statistics, London School of Hygiene and Tropical Medicine, London WC1E7HT, UK; and [5]The Zena and Michael A. Wiener Cardiovascular Institute, Icahn School of Medicine at Mount Sinai, New York, NY, USA

Received 14 May 2020; revised 1 July 2020; editorial decision 25 July 2020; accepted 29 July 2020; online publish-ahead-of-print 9 September 2020

WIN ratio analysis to Determine a strategy of non-invasive SUpport for Respiratory Failure in the EmeRgency Department trial (WINDSURFER)

- Two comparators
  - High flow nasal oxygen (HFNO)
  - Non-invasive positive pressure ventilation (NIPPV)
- Primary outcome – composite variable Major Adverse Pulmonary Events (MAPE)
  - Death
  - Ventilator Days
  - NIRS hours
- Primary hypothesis
  - H0: no difference in MAPE between HFNO and NIPPV.
  - HA: HFNO is superior to NIPPV

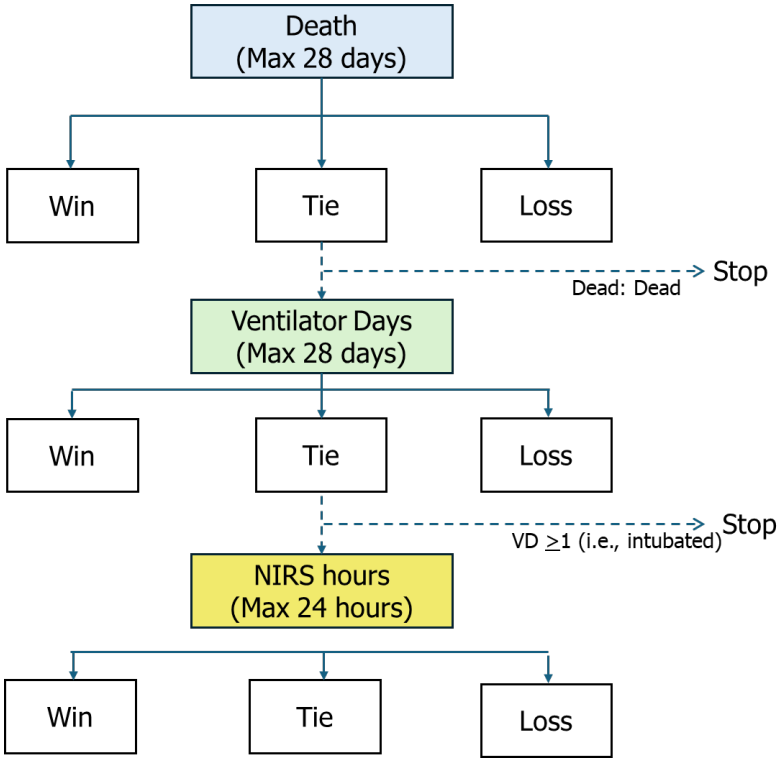
WINDSUFER trial design



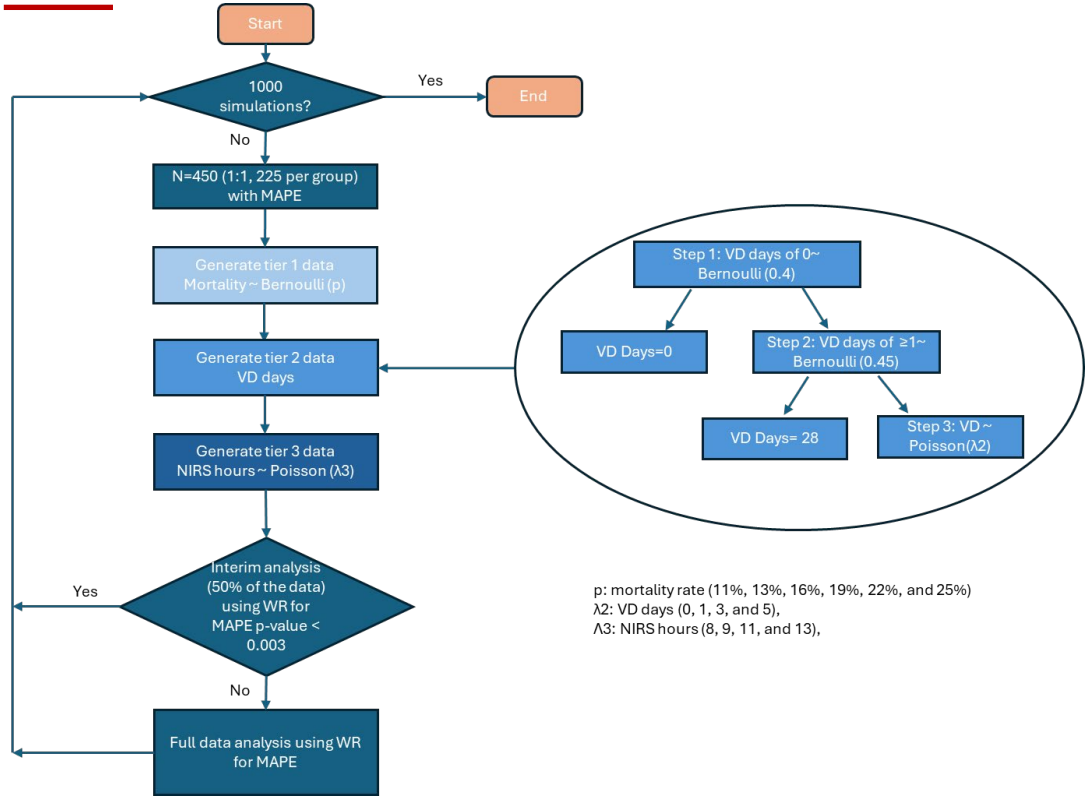
The Ohio State University
Wexner Medical Center

Analysis of MAPE using the WinRatio

- Compares the outcomes of all possible pairs of participants between the two intervention groups .
- Break ties only when clinically relevant.
- Determine Overall ratio of wins:losses.
- Use bootstrapping to determine the 95% confidence interval and statistical significance.



Sample size and power simulation diagram



p: mortality rate (11%, 13%, 16%, 19%, 22%, and 25%)
λ2: VD days (0, 1, 3, and 5),
Λ3: NIRS hours (8, 9, 11, and 13),

- 1,000 simulations per scenario
- Simulation distributions
  - Death – Bernoulli,
  - VD - mixed Bernoulli and Poisson,
  - NIRS – Poisson.
- An interim analysis of efficacy at 50% of data
- Using the Lan and DeMets version of the O'Brien-Fleming spending function

Parameters Used as Basis for WINDSURFER Sample Size Simulations

Parameters Used as Basis for WINDSURFER Sample Size Simulations.

Win Ratio Tier	MAPE Component	Baseline HFNO Value	Comparison NIPPV Values	Effect Sizes and Sources
Tier 1	Death (max 28d)	11% [Source: FLORALI]	11%, 13%, 16%	0%, 2%, 5% [UMich – Δ5% (low) FLORALI – Δ14% (high)]
Tier 2	Ventilator Days (max 28d)	0d [Source: UMich]	0d, 1d, 3d	0d, 1d, 3d [UMich – Δ0d (low) FLORALI – Δ5d (high)]
Tier 3	NIRS Hours (max 24h)	8h [Sources: FLORALI AND UMich]	8h, 11h, 13h	0h, 3h, 5h [FLORALI – Δ0h (low) UMich & Azevedo – Δ6h (high)]

Sample Size and Power

Scenario	Death (%)	Ventilato-Days (VD)	Non-Invasive Respiratory Support (NIRS) Hours	a) Power for Death only	b) Power for Death and VD days using WR	c) Power for Death, VFD and NIRS Hours using WR
--*	11% vs. 11%	0 vs. 0	8 vs. 8	--	--	Type I Error = 0.046*
A	11% vs. 11%	0 vs. 0	8 vs. 11	5%	5%	76.0%
B	11% vs. 11%	0 vs. 0	8 vs. 13	5%	5%	95.2%
C	11% vs. 11%	0 vs. 3	8 vs. 8	5%	76.5%	73.5%
D	11% vs. 11%	0 vs. 3	8 vs. 11	5%	76.5%	99.4%
E	11% vs. 11%	0 vs. 5	8 vs. 8	5%	80.4%	77.1%
F	11% vs. 11%	0 vs. 5	8 vs. 11	5%	80.4%	98.8%

- The simulated type I error rate was controlled under 0.05
- Using MAPE increased statistical power compared to using a single outcome or two outcomes.

Sample Size and Power (Continued)

Scenario	Death (%)	Ventilator Days (VFD)	Non-Invasive Respiratory Support (NIRS) Hours	a) Power for Death only	b) Power for Death and VD days using WR	c) Power for Death, VD and NIRS Hours using WR
G	11% vs. 13%	0 vs. 0	8 vs. 8	10%	8.5%	8.6%
H	11% vs. 13%	0 vs. 0	8 vs. 11	10%	8.5%	83.5%
I	11% vs. 13%	0 vs. 0	8 vs. 13	10%	8.5%	97.5%
J	11% vs. 13%	0 vs. 3	8 vs. 8	10%	84.5%	82.1%
K	**11% vs. 13%**	**0 vs. 3**	**8 vs. 11**	**10%**	**84.5%**	**99.0%**
L	11% vs. 13%	0 vs. 5	8 vs. 8	10%	87.8%	85.1%
M	11% vs. 13%	0 vs. 5	8 vs. 11	10%	87.8%	99.8%

- Scenario K: A 2% difference in mortality, a 3-day difference in ventilator days (VD), and a 3-hour difference in NIRS provided 99% power to detect differences using the MAPE method.
- Scenarios with more conservative effect sizes still maintained power >80%

Conclusion

- Study power increased with increasing death, vent days or NIRS hour differences.
- Yielded good power when at least one tier/outcome differed between NIPPV and HFNO.
- Observed adequate power to detect MAPE effectiveness even with slight differences in all three tiers/outcomes.
- MAPE increases the overall power compared to using either death alone or death + vent free days, with the degree of increase varying with clinical scenarios.

Interpretation and Communication

- Translating win ratio results into meaningful clinical recommendations can be challenging due to the complexity of the metric, especially when multiple endpoints are involved.
- Communicating the results to stakeholders (including clinicians, patients, and regulatory agent) may be difficult, particularly for those unfamiliar with the method.
- Broader acceptance of the win ratio approach by funding bodies and regulatory agencies may require increased awareness, validation studies, and clear demonstration of its clinical relevance.

Future Works

- Apply the Win Ratio design across diverse disease areas
- Incorporate patient matching
- Incorporate covariate information into the win ratio
- Test for treatment effect heterogeneity

Acknowledgments

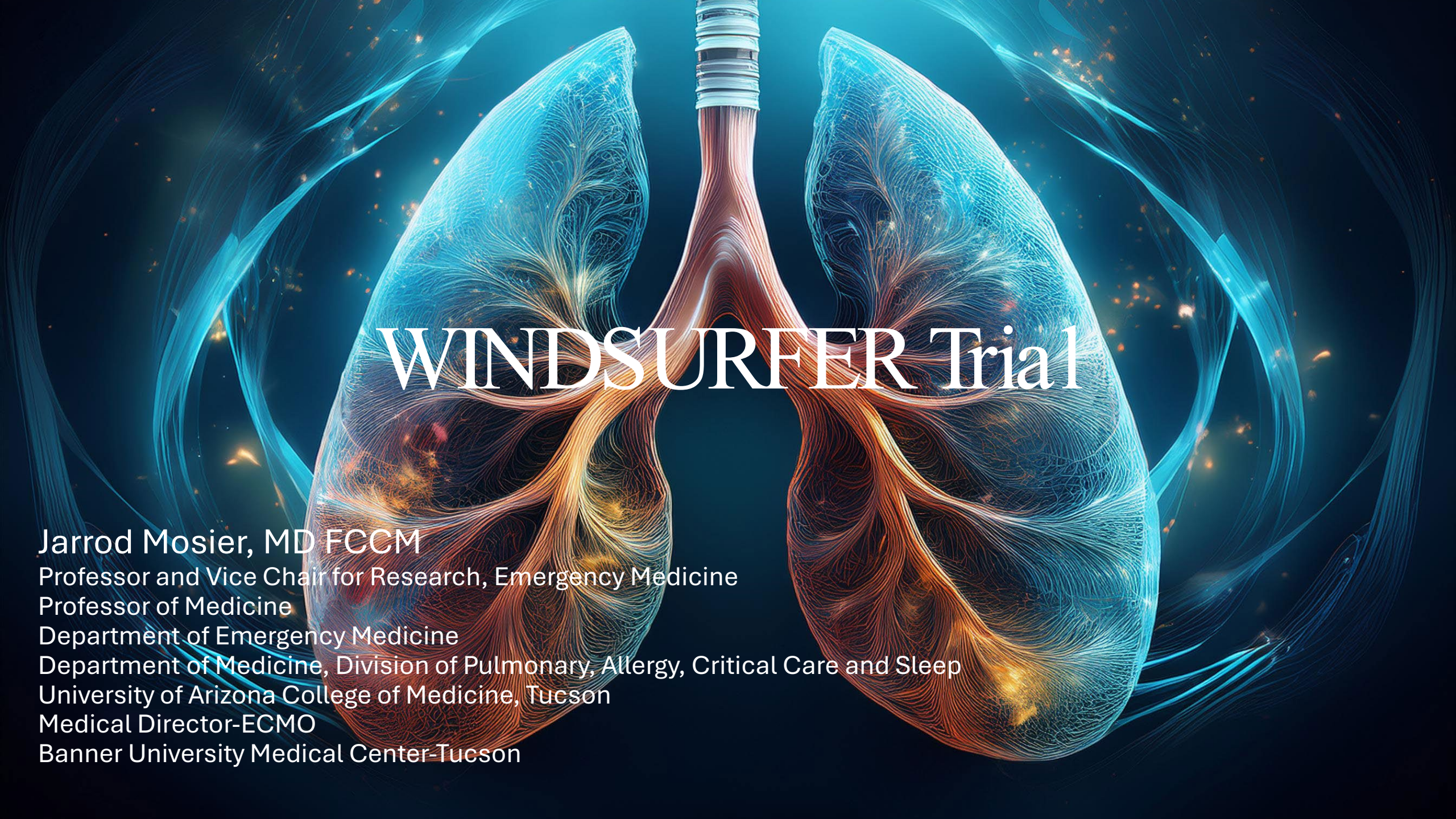
Statistical team:

- Rejuan Haque (OSU)
- Madison Hyer (OSU)
- Valerie Durkalski (MUSC)

Study team:

- Henry Wang (OSU)
- Jarrod Mosier (UA)
- Mark Tidswell (Baystate Health)
- William Meurer (UMich)
- Elizabeth Munroe (UMich)

Thank You



WINDSURFER Trial

Jarrod Mosier, MD FCCM
Professor and Vice Chair for Research, Emergency Medicine
Professor of Medicine
Department of Emergency Medicine
Department of Medicine, Division of Pulmonary, Allergy, Critical Care and Sleep
University of Arizona College of Medicine, Tucson
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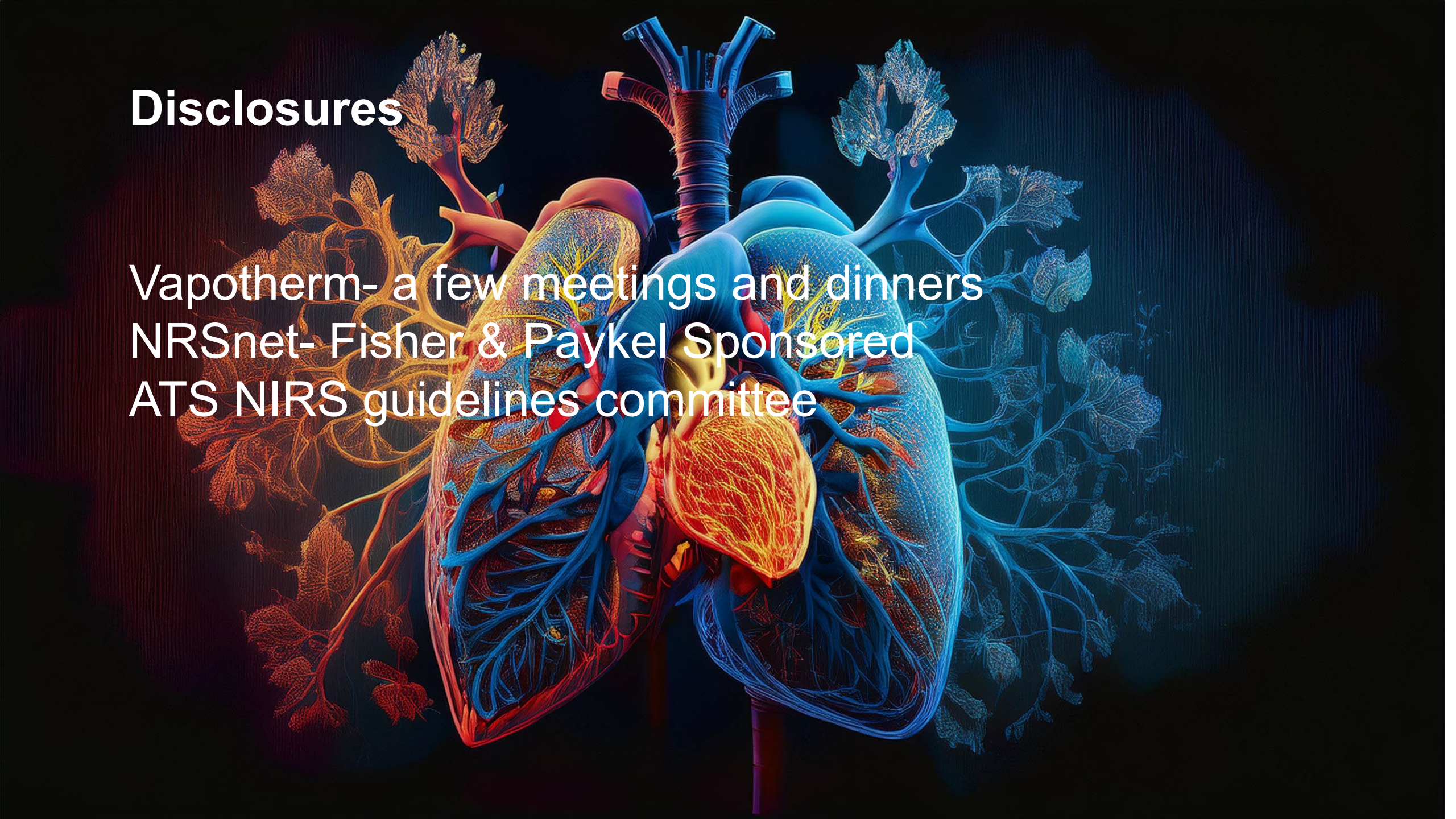
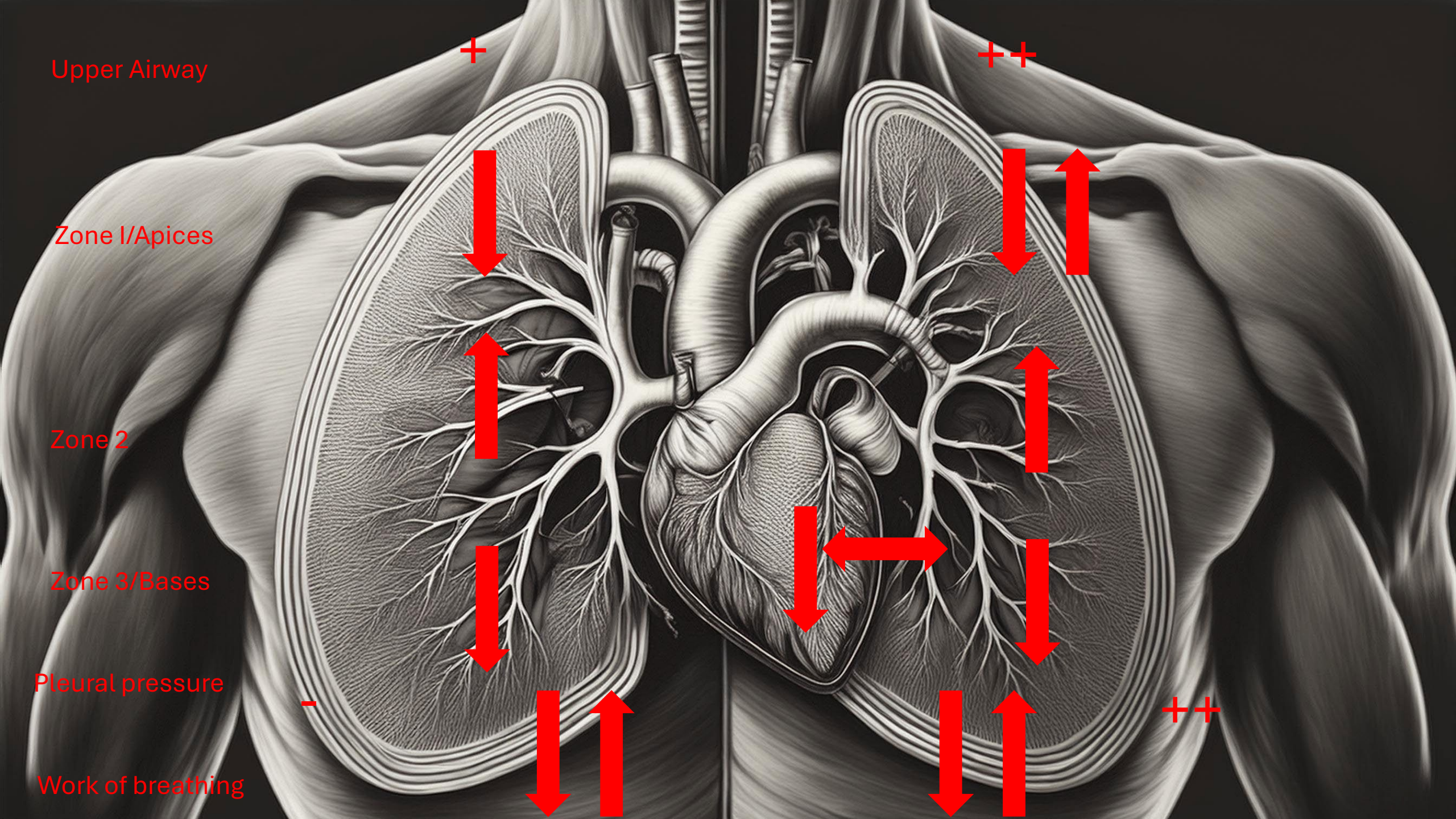
Disclosures



Vapotherm- a few meetings and dinners
NRSnet- Fisher & Paykel Sponsored
ATS NIRS guidelines committee


Upper Airway
+
++
Zone I/Apices
Zone 2
Zone 3/Bases
Pleural pressure
-
++
Work of breathing

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JUNE 4, 2015 VOL. 372 NO. 23

High-Flow Oxygen through Nasal Cannula in Acute Hypoxemic Respiratory Failure

Jean-Pierre Frat, M.D., Arnaud W. Thille, M.D., Ph.D., Alain Mercat, M.D., Ph.D., Christophe Girault, M.D., Ph.D., Stéphanie Ragot, Pharm.D., Ph.D., Sébastien Perbet, M.D., Gwénael Prat, M.D., Thierry Boulain, M.D., Elise Morawiec, M.D., Alice Cottereau, M.D., Jérôme Devaquet, M.D., Saad Nseir, M.D., Ph.D., Keyvan Razazi, M.D., Jean-Paul Mira, M.D., Ph.D., Laurent Argaud, M.D., Ph.D., Jean-Charles Chakarian, M.D., Jean-Damien Ricard, M.D., Ph.D., Xavier Wittebole, M.D., Stéphanie Chevalier, M.D., Alexandre Herbland, M.D., Muriel Fartoukh, M.D., Ph.D., Jean-Michel Constantin, M.D., Ph.D., Jean-Marie Tonnelier, M.D., Marc Pierrot, M.D., Armelle Mathonnet, M.D., Gaëtan Béduneau, M.D., Céline Delétage-Métreau, Ph.D., Jean-Christophe M. Richard, M.D., Ph.D., Laurent Brochard, M.D., and René Robert, M.D., Ph.D., for the FLORALI Study Group and the REVA Network*

Table 2. Primary and Secondary Outcomes, According to Study Group.*

Outcome	Study Group			P Value†	Odds Ratio or Hazard Ratio (95% CI)	
	High-Flow Oxygen (N=106)	Standard Oxygen (N=94)	Noninvasive Ventilation (N=110)		Standard Oxygen vs. High-Flow Oxygen	Noninvasive Ventilation vs. High-Flow Oxygen
Intubation at day 28						
Overall population				0.18	1.45 (0.83–2.55)	1.65 (0.96–2.84)
No. of patients	40	44	55			
% of patients (95% CI)	38 (29–47)	47 (37–57)	50 (41–59)			
Patients with Pao_2:FIO_2 ≤200 mm Hg‡						
Unadjusted analysis				0.009	2.07 (1.09–3.94)	2.57 (1.37–4.84)
No. of patients/total no.	29/83	39/74	47/81			
% of patients (95% CI)	35 (26–46)	53 (42–64)	58 (47–68)			
Adjusted analysis§	—	—	—	0.01	2.14 (1.08–4.22)	2.60 (1.36–4.96)
Interval between enrollment and intubation — hr¶						
Overall population				0.27	—	—
Median	27	15	27			
Interquartile range	8–46	5–39	8–53			
Patients with Pao_2:FIO_2 ≤200 mm Hg				0.32	—	—
Median	26	17	27			
Interquartile range	11–46	5–41	7–52			
Reason for intubation — no./total no. (%)‖						
Respiratory failure	36/51 (71)	43/58 (74)	49/67 (73)	0.24	—	—
Circulatory failure	7/51 (14)	5/58 (9)	5/67 (7)	0.46	—	—
Neurologic failure	8/51 (16)	10/58 (17)	13/67 (19)	0.91	—	—
Ventilator-free days						
Overall population	24±8	22±10	19±12	0.02	—	—
Patients with Pao_2:FIO_2 ≤200 mm Hg	24±8	21±10	18±12	<0.001	—	—

Table 2. (Continued.)

Outcome	Study Group			P Value†	Odds Ratio or Hazard Ratio (95% CI)	
	High-Flow Oxygen (N=106)	Standard Oxygen (N=94)	Noninvasive Ventilation (N=110)		Standard Oxygen vs. High-Flow Oxygen	Noninvasive Ventilation vs. High-Flow Oxygen
Death						
In ICU						
Unadjusted analysis				0.047	1.85 (0.84–4.09)	2.55 (1.21–5.35)
No. of patients	12	18	27			
% of patients (95% CI)	11 (6–19)	19 (12–28)	25 (17–33)			
Adjusted analysis**	—	—	—	—	2.55 (1.07–6.08)	2.60 (1.20–5.63)
At day 90						
Overall population						
Unadjusted analysis				0.02	2.01 (1.01–3.99)	2.50 (1.31–4.78)
No. of patients	13	22	31			
% of patients (95% CI)	12 (7–20)	23 (16–33)	28 (21–37)			
Adjusted analysis**	—	—	—	—	2.36 (1.18–4.70)	2.33 (1.22–4.47)
Intubated patients				0.16		
No. of patients/total. no.	12/40	20/44	27/55			
% of patients (95% CI)	30 (18–46)	45 (32–60)	49 (36–62)			
Cause of death — no./total no. (%)						
Refractory shock	6/13 (46)	12/22 (55)	18/31 (58)	0.04		
Refractory hypoxemia	5/13 (38)	6/22 (27)	8/31 (26)	0.73		
Cardiac arrest	1/13 (8)	1/22 (5)	3/31 (10)	0.52		
Other	1/13 (8)	3/22 (14)	2/31 (6)	0.52		

JAMA | Original Investigation | CARING FOR THE CRITICALLY ILL PATIENT

High-Flow Nasal Oxygen vs Noninvasive Ventilation in Patients With Acute Respiratory Failure

The RENOVATE Randomized Clinical Trial

RENOVATE Investigators and the BRICNet Authors

Figure 1:Study Flow-chart

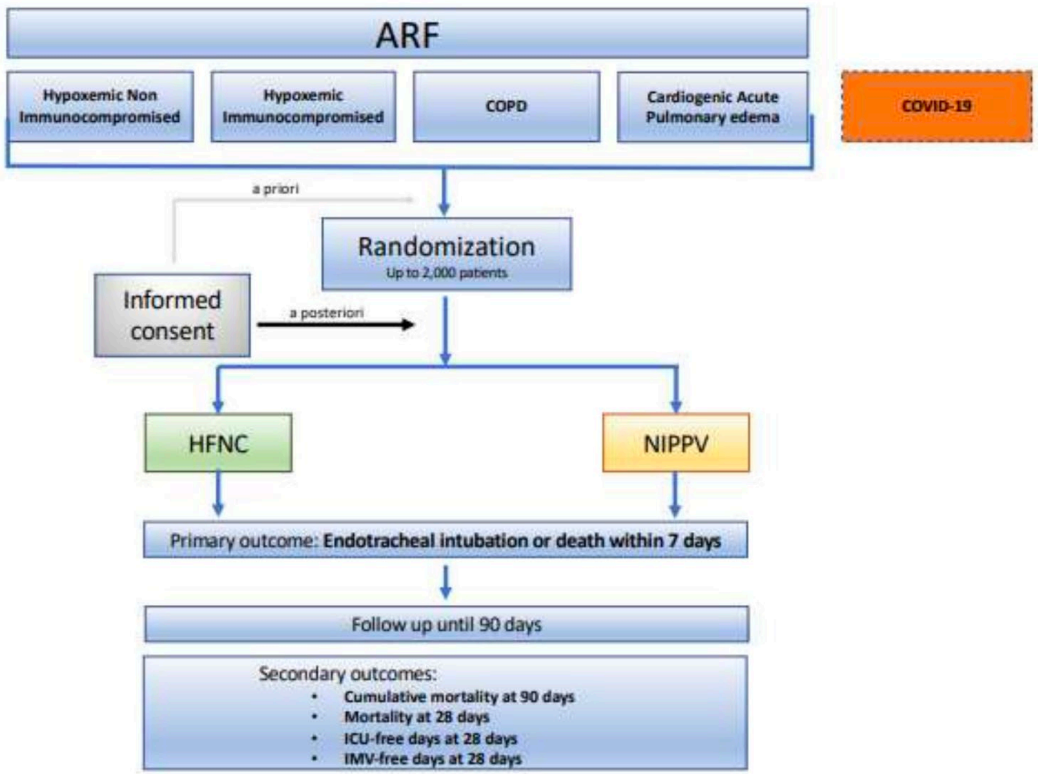
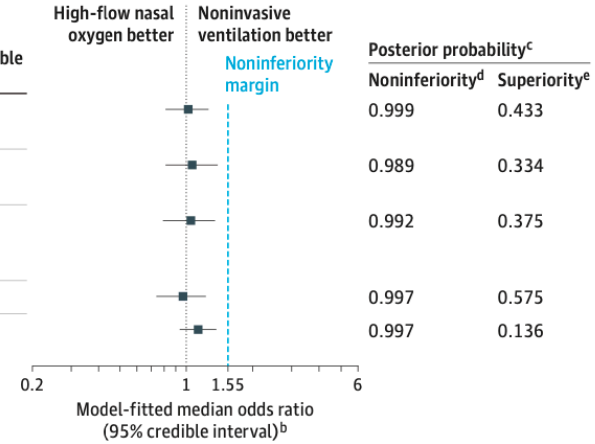


Figure 2. Primary Outcome of Endotracheal Intubation or Death Within 7 Days

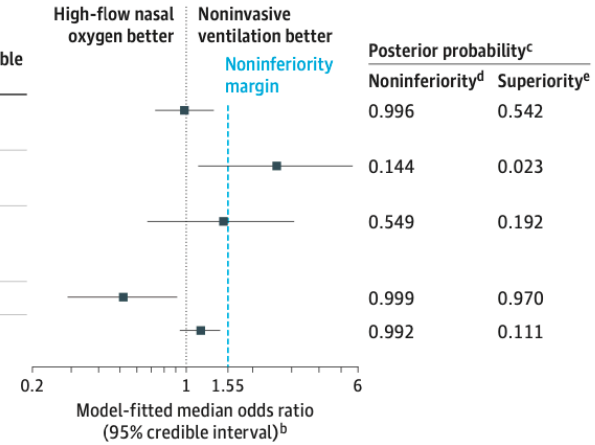
A Analysis of the primary outcome[a]

Patients with acute respiratory failure	No./total (%)		Model-fitted median odds ratio (95% credible interval)[b]	Posterior probability[c]	
	High-flow nasal oxygen	Noninvasive ventilation		Noninferiority[d]	Superiority[e]
Nonimmunocompromised with hypoxemia	81/249 (32.5)	78/236 (33.1)	1.02 (0.81-1.26)	0.999	0.433
Immunocompromised with hypoxemia	16/28 (57.1)	8/22 (36.4)	1.07 (0.81-1.39)	0.989	0.334
Chronic obstructive pulmonary disease exacerbation with respiratory acidosis	10/35 (28.6)	11/42 (26.2)	1.05 (0.79-1.36)	0.992	0.375
Acute cardiogenic pulmonary edema	14/136 (10.3)	29/136 (21.3)	0.97 (0.73-1.23)	0.997	0.575
Hypoxemic COVID-19	223/435 (51.3)	210/447 (47.0)	1.13 (0.94-1.38)	0.997	0.136



B Post hoc analysis of the primary outcome[f]

Patients with acute respiratory failure	No./total (%)		Model-fitted median odds ratio (95% credible interval)[b]	Posterior probability[c]	
	High-flow nasal oxygen	Noninvasive ventilation		Noninferiority[d]	Superiority[e]
Nonimmunocompromised with hypoxemia	81/249 (32.5)	78/236 (33.1)	0.98 (0.73-1.33)	0.996	0.542
Immunocompromised with hypoxemia	16/28 (57.1)	8/22 (36.4)	2.56 (1.14-5.68)	0.144	0.023
Chronic obstructive pulmonary disease exacerbation with respiratory acidosis	10/35 (28.6)	11/42 (26.2)	1.48 (0.67-3.09)	0.549	0.192
Acute cardiogenic pulmonary edema	14/136 (10.3)	29/136 (21.3)	0.52 (0.29-0.91)	0.999	0.970
Hypoxemic COVID-19	223/435 (51.3)	210/447 (47.0)	1.16 (0.94-1.43)	0.992	0.111



[a]Includes all randomized patients with informed consent. The primary outcome was analyzed with a bayesian hierarchical modeling with dynamic borrowing across the 5 patient groups with acute respiratory failure. More borrowing occurs when the groups are consistent, and less borrowing occurs when the groups differ. Borrowing via a hierarchical model is a type of shrinkage estimation (it provides a formal mechanism by which extreme observations are shrunk toward the mean). The model is a compromise between the extremes of a completely pooled analysis as opposed to a separate analysis in each group.

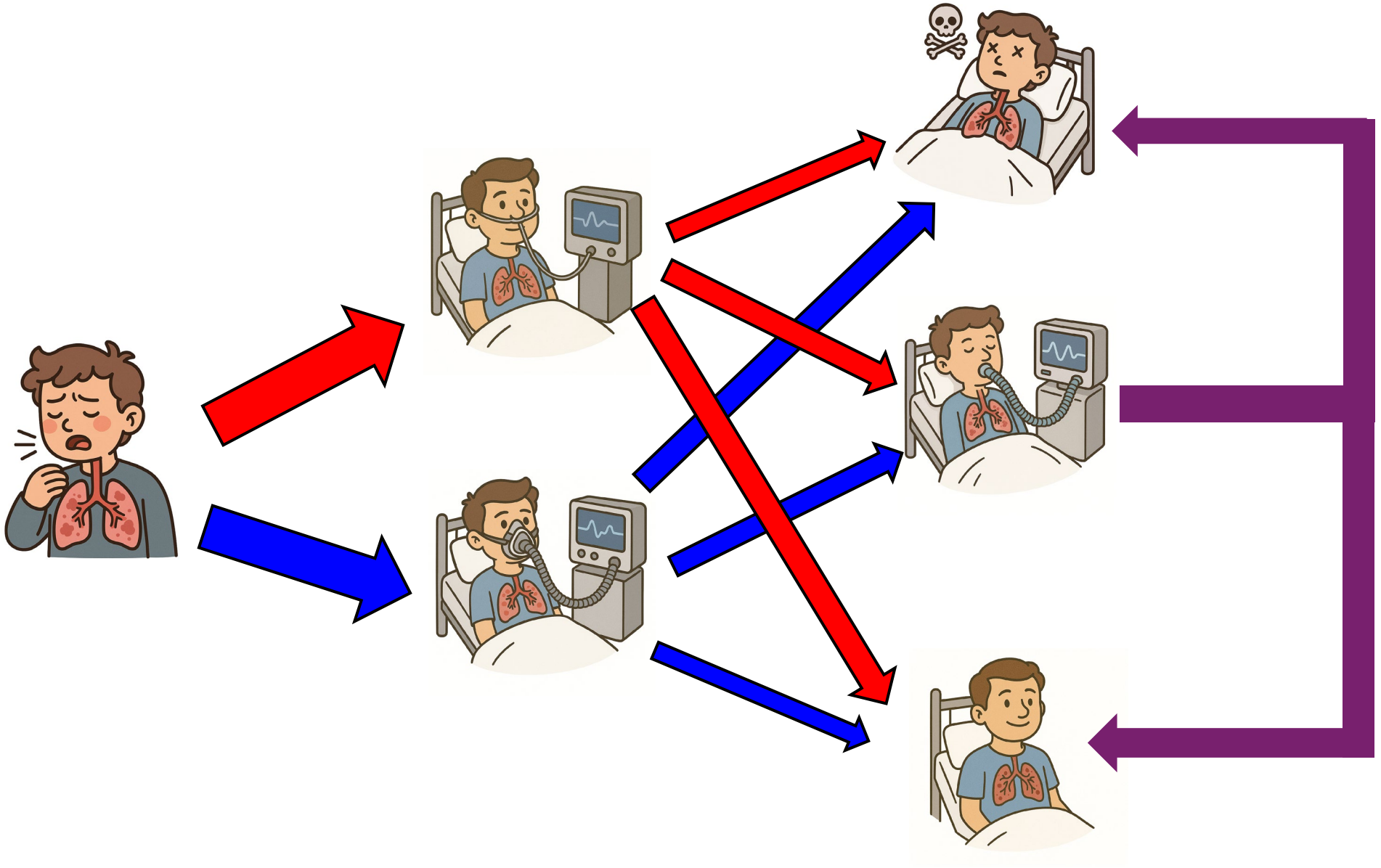
[b]Odds of requiring endotracheal intubation or dying within 7 days in the high-flow nasal oxygen group vs the noninvasive ventilation group.

[c]A bayesian approach based on posterior probabilities was used to test the noninferiority and superiority hypotheses with predefined thresholds.

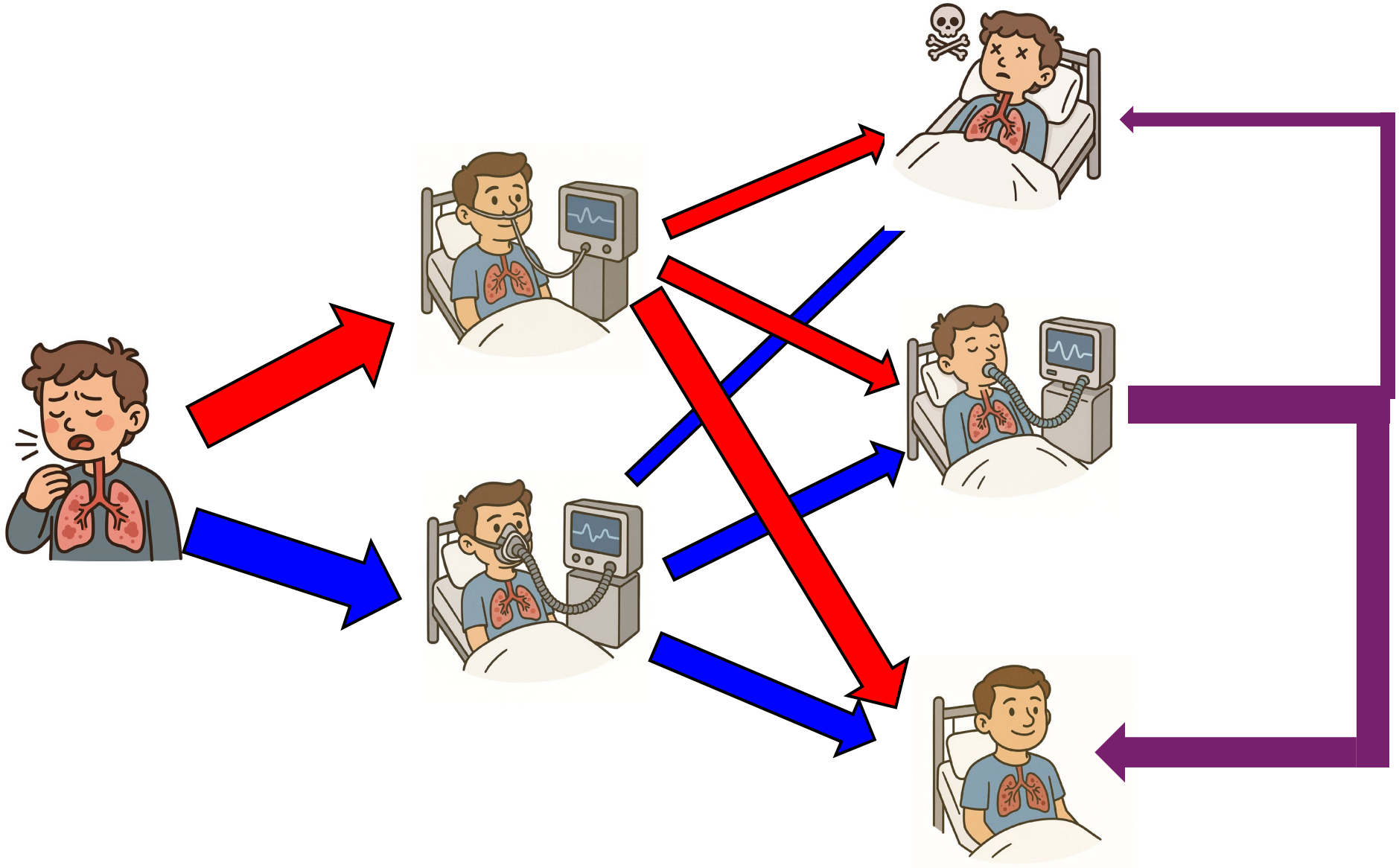
[d]Defined as a posterior probability greater than 0.992 that the odds ratio was less than 1.55. For each patient group with acute respiratory failure, noninferiority was declared if the posterior probability was greater than 0.992. If noninferiority was not demonstrated, the final result was futility.

[e]Defined as a posterior probability greater than 0.992 that the odds ratio was less than 1. If noninferiority was demonstrated, then superiority was declared if the superiority posterior probability was also higher than 0.992.

[f]The same bayesian model structure was used as in the primary analysis, but without borrowing. Although borrowing can improve precision under the assumption of similar treatment effects, it could also produce biased estimates when there is heterogeneity across groups.



- Outcome Options
  1. Intubation
  2. Mortality
  3. Ventilator-free days
  4. Respiratory-support free days



1. *Will I die?*
2. *If I get intubated, will I b*
   on the ventilator longer?
3. *Will I have to be on one*
   longer than the other?

Do Thresholds for Invasive Ventilation in Hypoxemic Respiratory Failure Exist?

A Cohort Study

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American Journal of Respiratory and Critical Care Medicine, 2023, Volume 207 Number 3

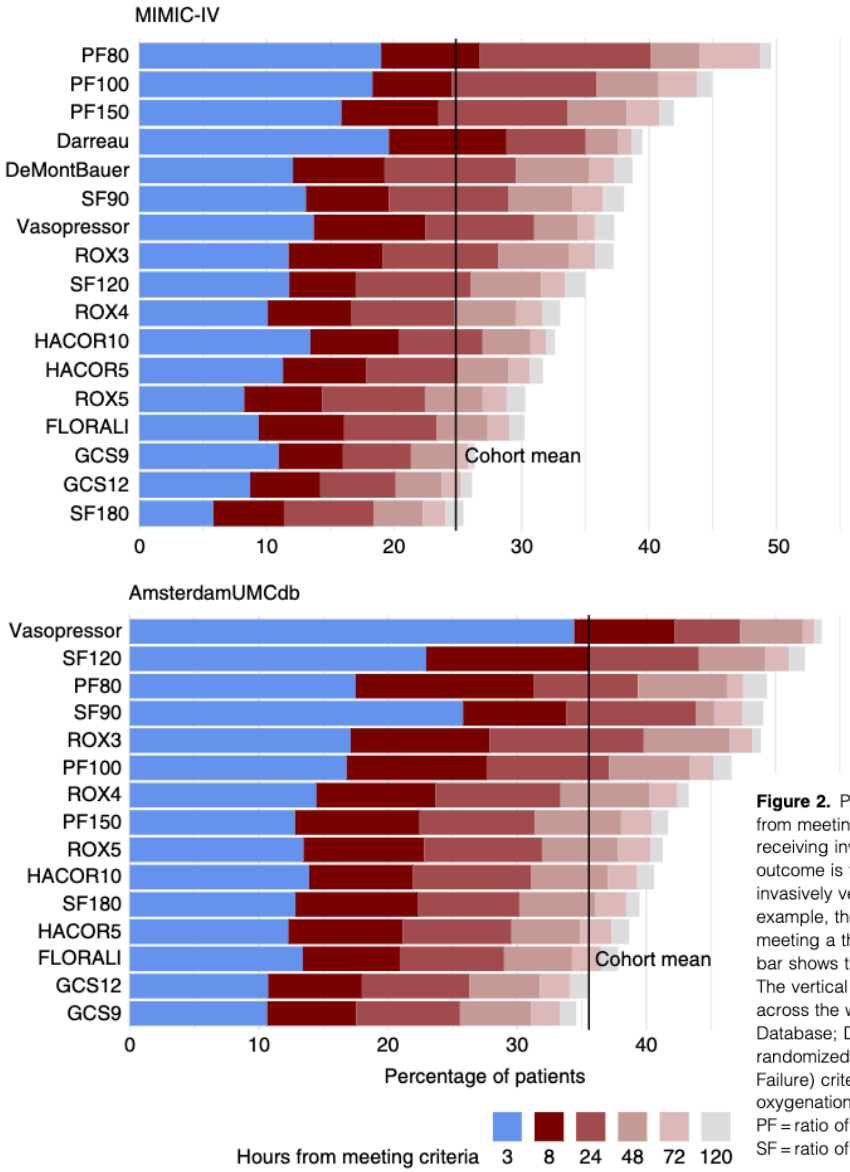
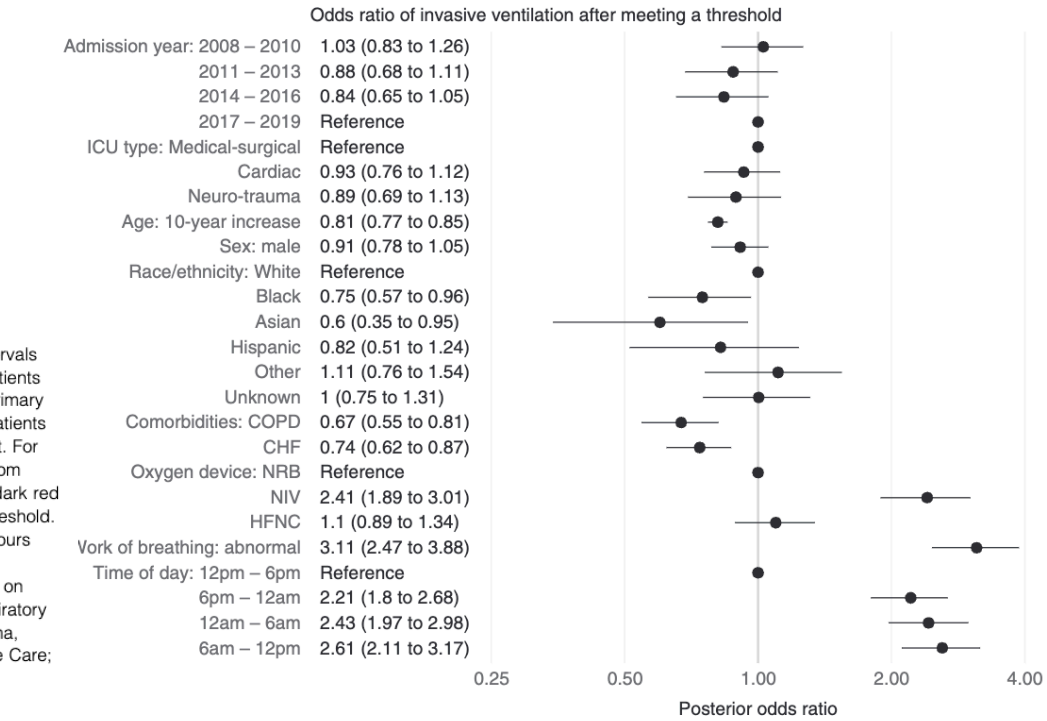


Figure 2. Percentage of patients receiving invasive ventilation within different time intervals from meeting thresholds. This figure shows a stacked bar plot of the percentage of patients receiving invasive ventilation within different time intervals from meeting criteria. The primary outcome is filled in blue (invasive ventilation within 3 h). The additional proportion of patients invasively ventilated by the end of the next interval appears as the next bar to the right. For example, the total percentage of patients invasively ventilated by the end of 8 hours from meeting a threshold is given by the combination of blue and dark red bars, while the dark red bar shows the patients invasively ventilated between 3 and 8 hours after meeting a threshold. The vertical line shows the mean percentage of patients invasively ventilated by 120 hours across the whole cohort. AmsterdamUMCdb = Amsterdam University Medical Centers Database; DeMontBauer = de Montmollin–Bauer threshold; FLORALI = threshold based on randomized trial (High-Flow Oxygen through Nasal Cannula in Acute Hypoxemic Respiratory Failure) criteria; GCS = Glasgow Coma Scale score; HACOR = heart rate, acidosis, coma, oxygenation, and respiratory rate score; MIMIC = Medical Information Mart for Intensive Care; PF = ratio of arterial to inspired oxygen; ROX = respiratory rate and oxygenation index; SF = ratio of saturation to inspired oxygen.

Table 4. Outcomes by Threshold and Oxygen Device at the Time of Meeting a Threshold, MIM

Category	Threshold	Total Who Met Threshold (*n*)	Patients on NIV When Threshold Met [*n* (%)]		Patients on HFNC When Threshold Met [*n* (%)]		
			Met Threshold	IMV after Meeting Threshold	Met Threshold	NIV	IMV
Validated clinical scores/ indices	P:F < 80	232	27 (12)	3 (11)	75 (32)	2 (3)	16 (21)
	P:F < 100	432	44 (10)	6 (14)	117 (27)	4 (3)	19 (16)
	P:F < 150	813	107 (13)	14 (13)	170 (21)	8 (5)	22 (13)
	S:F < 90	607	65 (11)	8 (12)	280 (46)	13 (5)	28 (10)
	S:F < 120	1,514	185 (12)	26 (14)	462 (31)	17 (4)	36 (8)
	S:F < 180	3,082	320 (10)	28 (9)	511 (17)	12 (2)	25 (5)
	ROX < 3	785	94 (12)	10 (11)	292 (37)	10 (3)	27 (9)
	ROX < 4	1,571	178 (11)	21 (12)	434 (28)	14 (3)	30 (7)
	ROX < 5	2,227	250 (11)	26 (10)	502 (23)	15 (3)	30 (6)
	HACOR > 10	606	87 (14)	12 (14)	128 (21)	5 (4)	11 (9)
	HACOR > 5	1,757	241 (14)	33 (14)	358 (20)	13 (4)	30 (8)
Clinical trial	FLORALI	2,027	284 (14)	30 (11)	431 (21)	18 (4)	32 (7)
Observational research	Darreau	259	37 (14)	8 (22)	53 (20)	2 (4)	11 (21)
	DeMontBauer	607	71 (12)	9 (13)	236 (39)	8 (3)	22 (9)
Nonrespiratory	Vasopressor	526	66 (13)	12 (18)	93 (18)	6 (6)	10 (11)
	GCS score < 9	714	92 (13)	15 (16)	140 (20)	5 (4)	13 (9)
	GCS score < 12	1,441	195 (14)	23 (12)	296 (21)	8 (3)	19 (6)



Death
(Max 28 days)

Win | Tie | Loss

Dead: Dead → Stop

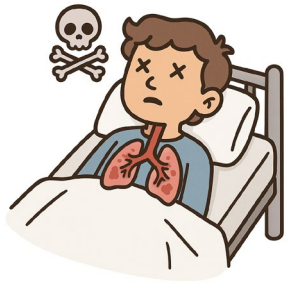
Ventilator Days
(Max 28 days)

Win | Tie | Loss

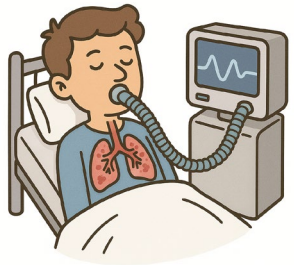
VD ≥1 (i.e., intubated) → Stop

NIRS hours
(Max 24 hours)

Win | Tie | Loss



"With which one will I be less likely to die?"



"If I don't die, but get intubated, with which one will I get off the ventilator faster?"

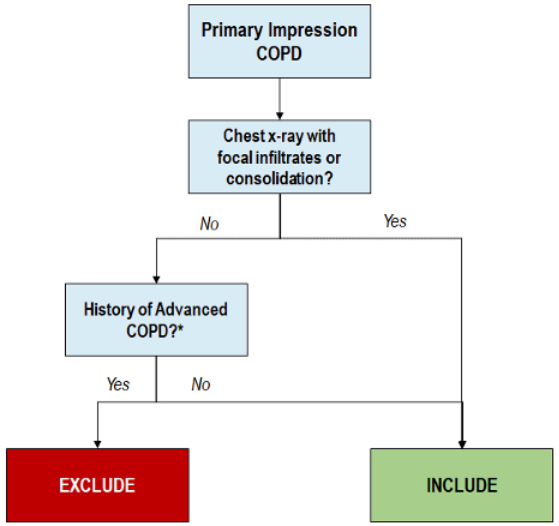
"Is one more iatrogenically injurious than the other?"

"If I don't die or get intubated, with which one will I get better faster?"

THE UNIVERSITY OF ARIZONA | COLLEGE OF MEDICINE

WINDSURFER

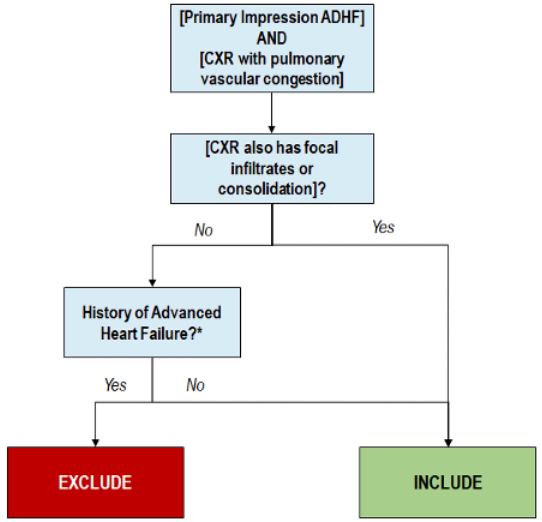
Isolated Acute Exacerbation of Advanced COPD



*Known or documented history of ***advanced*** COPD, as indicated by >1 of the following identified on history or chart review:

- Chronic home oxygen therapy
- Hospice for end stage lung disease
- ≥1 hospital visits for acute exacerbation of COPD in the past year
- Home use of NIPPV for respiratory support (unless only for nocturnal obstructive sleep apnea)
- Lung volume reduction surgery or endobronchial valves for emphysema, or lung transplantation
- Participation in pulmonary rehabilitation for COPD in the past year
- GOLD 3 or 4 [FEV1 < 50%] classification

Isolated Acute Decompensation of Advanced Heart Failure



*Known or documented history of ***advanced*** heart failure, as indicated by >1 of the following identified on history or chart review:

- New York Heart Association Class III or IV or American Heart Association Class C or D heart failure
- Any outpatient therapy for advanced heart failure, including: nitrates plus hydralazine, ivrabadine, home infusion of inotropes, automated implanted cardiac defibrillator (AICD), or mechanical circulatory support device.

In Summary:

- The Win ratio provides the best option to account for patient-centered outcomes of varying severities (death vs intubation vs length-of-stay) in critically ill respiratory failure patients.