*Annual Board Review and Update in*
*Pulmonary and Critical Care Medicine* course

# *Management of the Chronic Respiratory Failure Patient*

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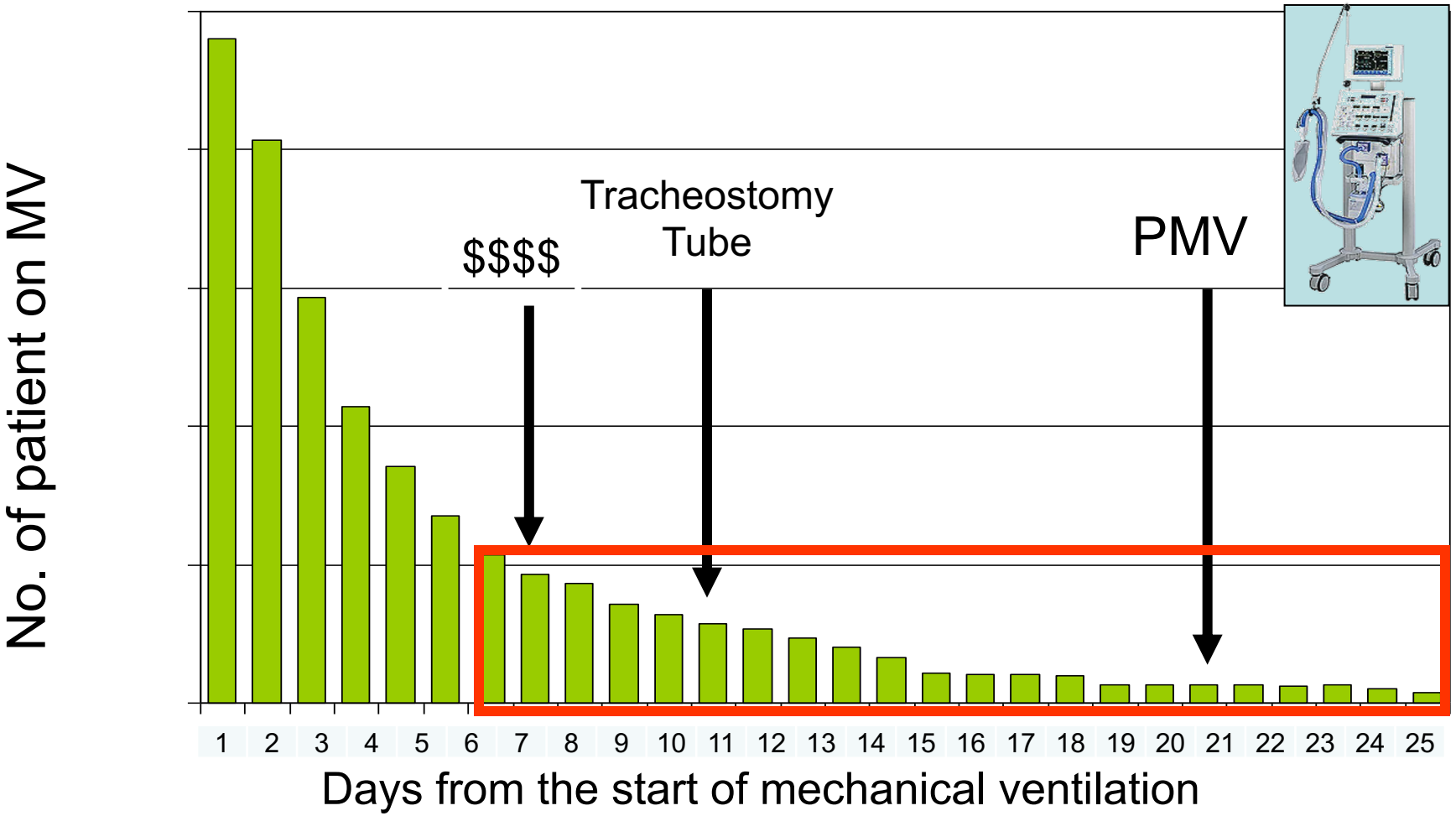
# Conflict of Interest Disclosure

I have no financial relationships with commercial entities producing, marketing, re-selling, or distributing health care goods or services consumed by or used on patients.

# Objectives

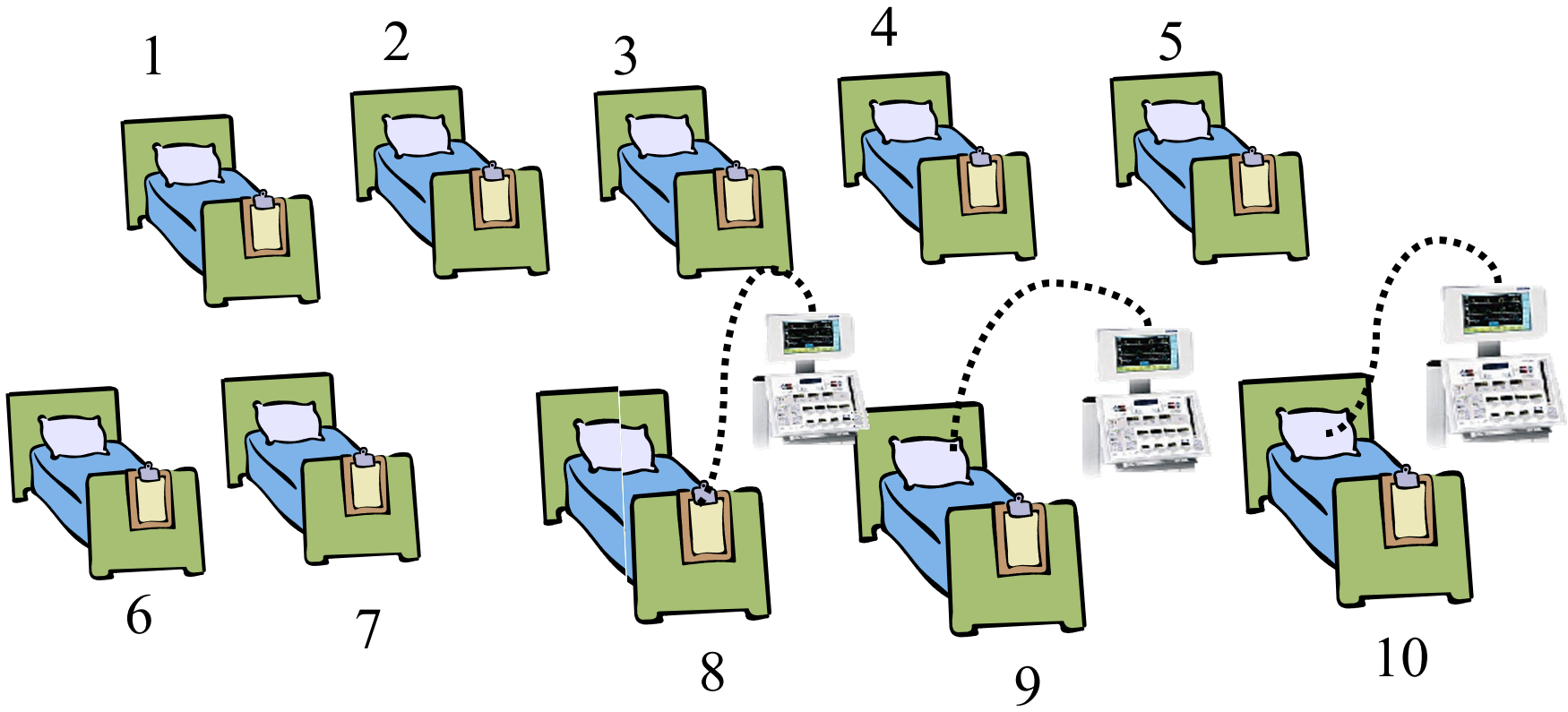
1. Epidemiology of the Chronic Respiratory Failure
2. Pathophysiology of respiratory failure
3. Methods used to liberate from prolonged mechanical ventilation
4. Outcomes

# Mechanical Ventilation Multicenter Prevalence Study




Esteban A et al. *JAMA. 287(3):345-355, 2002.*
Esteban A et al, *Am J Respir Crit Care Med.161(5):1450-8, 2000*

# How Big is the Problem?




Esteban A,, et al.. N Engl J Med 1995;332:345-50. 63.

Brochard L, et al.. Am J Respir Crit Care Med 1994;150:896-903.

# PMV are not created equal

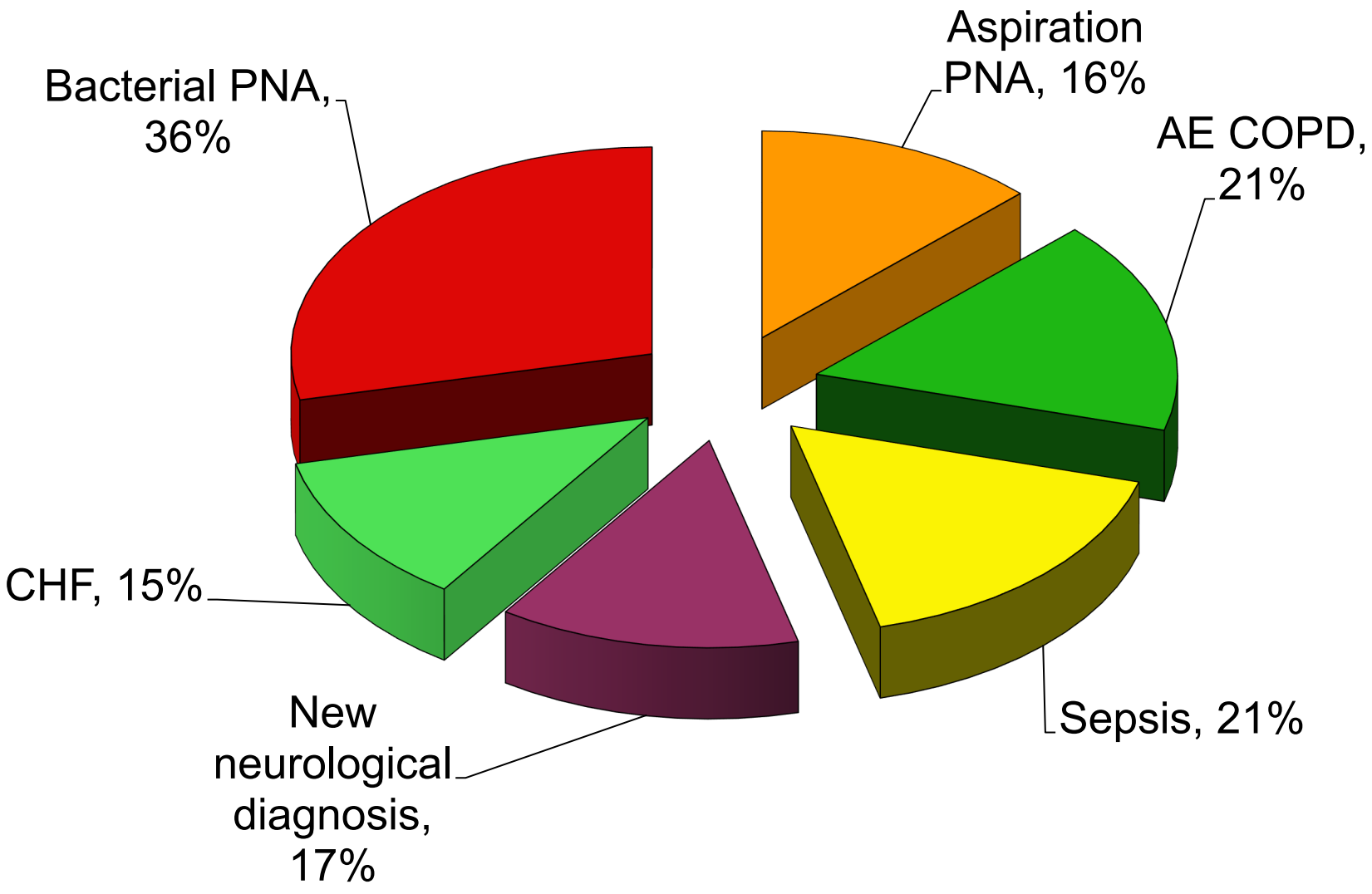
Neuromuscular diseases

- Reversible
- Irreversible

Chronically Critically ill Debilitated Patient Survivor of a Catastrophic Event

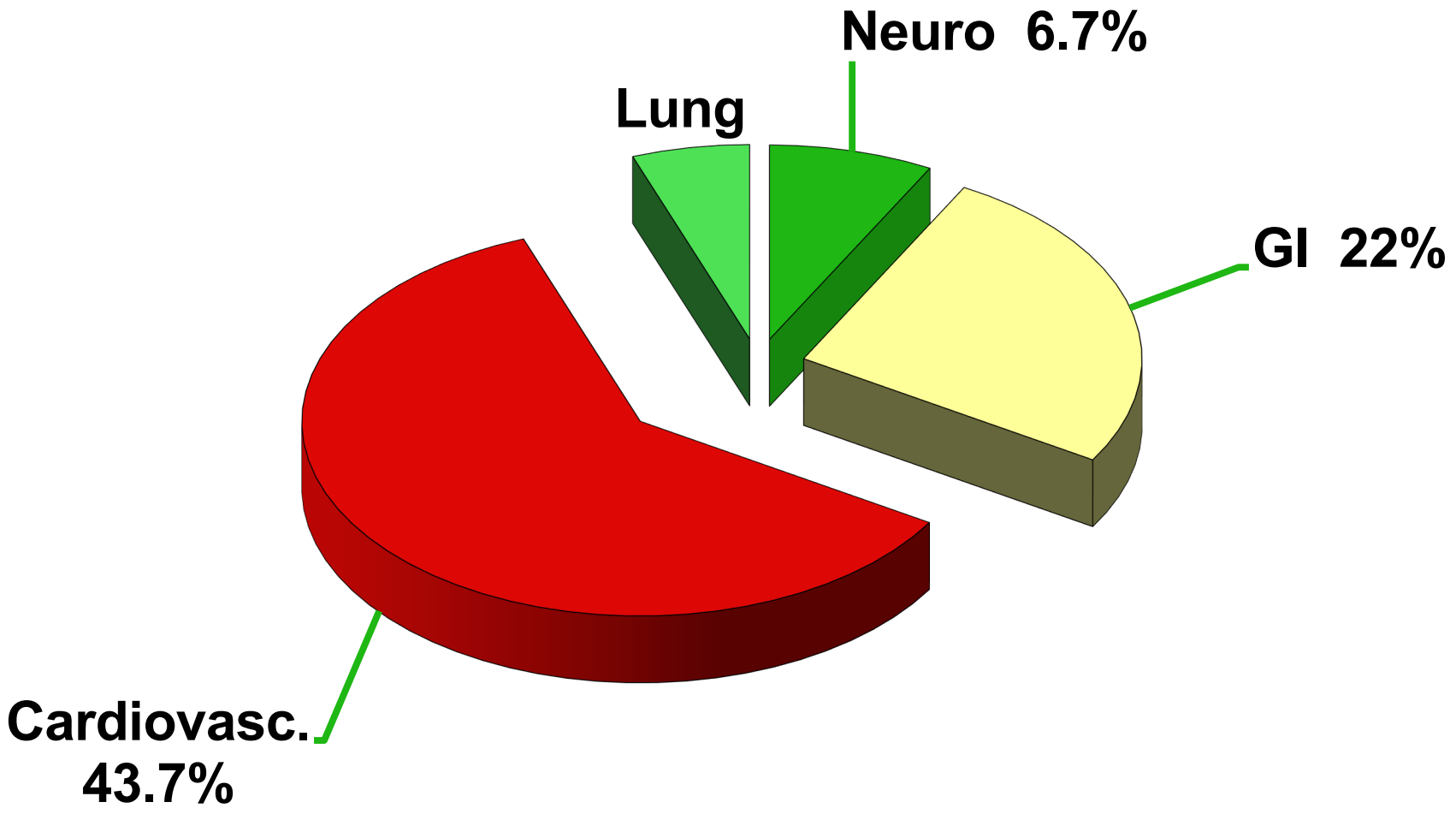
- Post-surgical
- Medical

# Medical diagnoses resulting in PMV: 61%



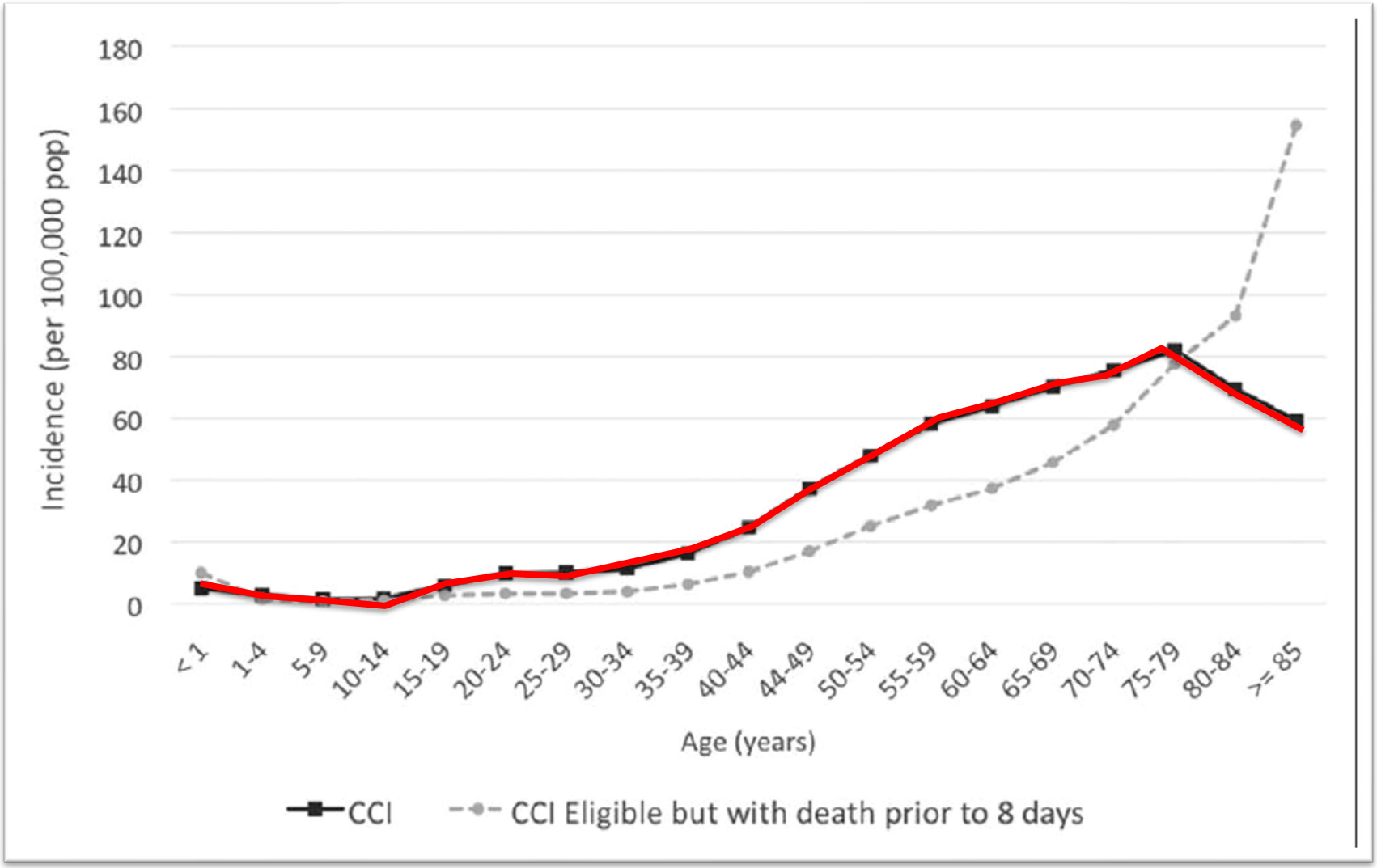

DJ Scheinhorn et al Chest 2007

# Surgical diagnoses resulting in PMV: 39%



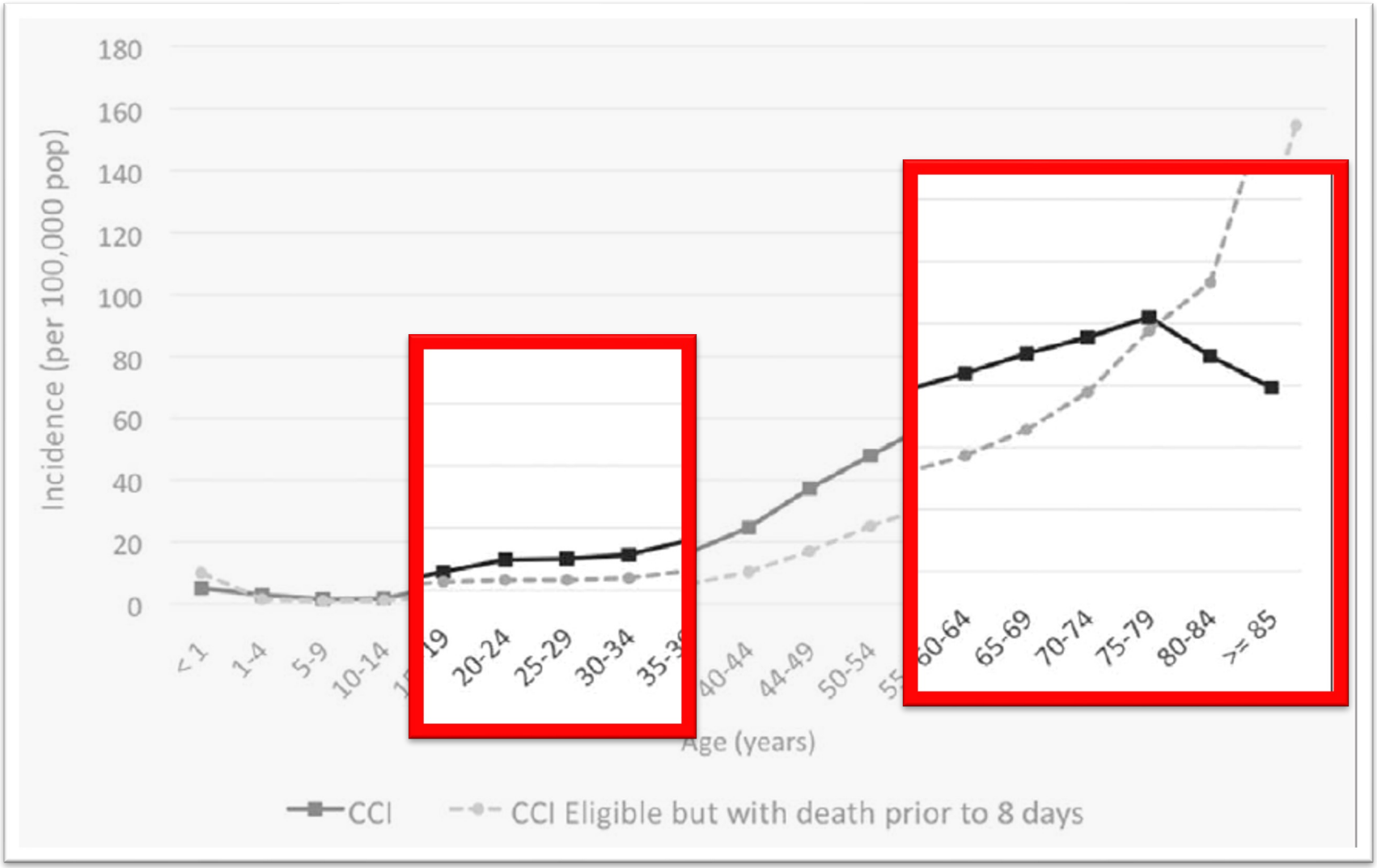

DJ Scheinhorn et al Chest 2007

# The Epidemiology of Chronic Critical Illness in the United States*




*Khan et al, Crit Care Med* 2015; 43:282–287

# The Epidemiology of Chronic Critical Illness in the United States*




*Khan et al, Crit Care Med* 2015; 43:282–287

# Learning Points 1

1. Chronic respiratory failure patients are the product of our own medical advances and success
2. Affect mostly the elderly, however genetic, trauma, overdose affect mostly young individuals
3. Up to 20-30% of our ICU patients meet criteria of prolonged MV

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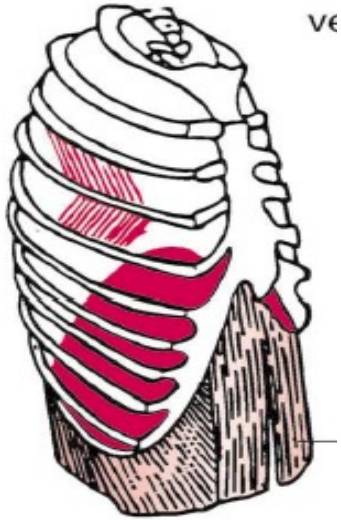
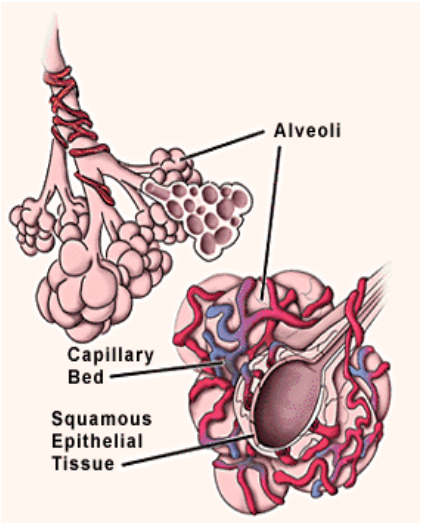
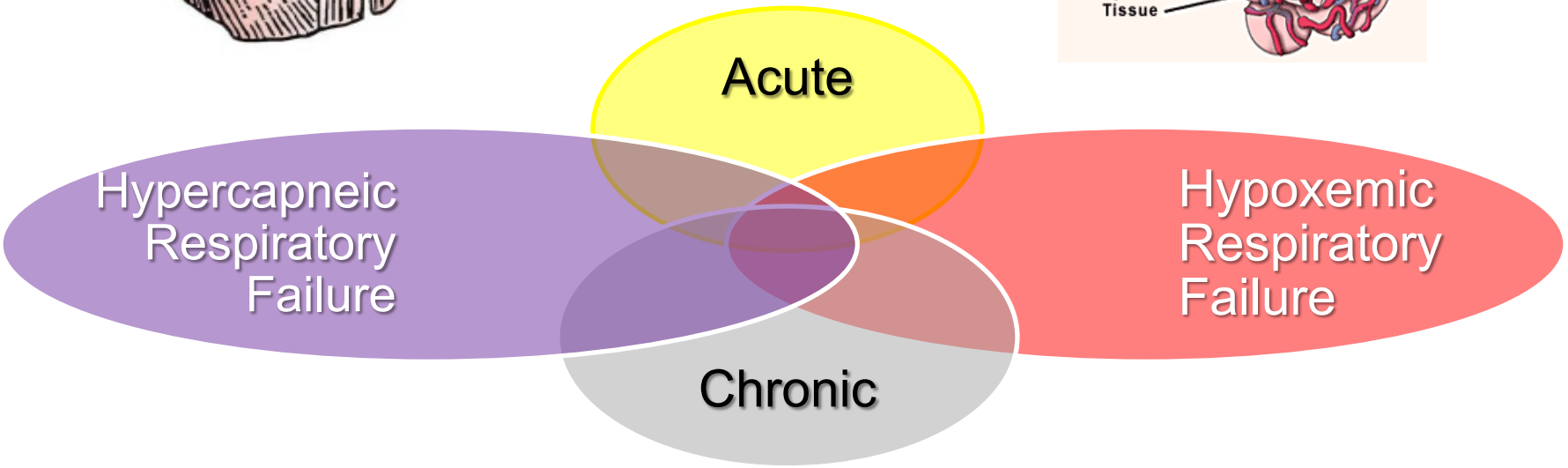
# Respiratory Failure

## Ventilatory Pump: PaCO2

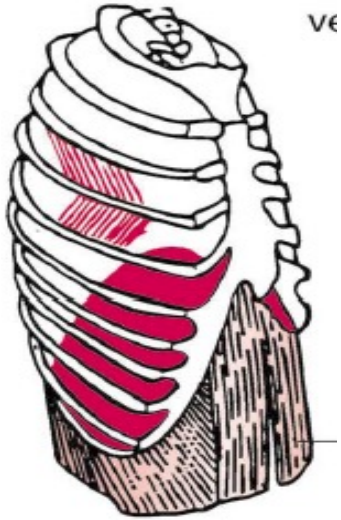


## Gas Exchange: PaO2



# Hypercapnic Respiratory Failure



$$\text{PaCO2} = \frac{VCO2}{VA}$$

$$\text{VA} = (RR * Vt)\left(1 - \frac{Vd}{Vt}\right)$$

# Determinant of fatigue

Task to be performed 24 X 7 X lifetime

↓ CAPACITY

↓ ENERGY SUPPLY

↑ LOAD

Intensity of the load

Duration of Contraction

Purro, AJRCCM 2000

Bellemare, J. Appl. Physiol. 1982

Vassilakopoulos, Eur Resp J., 1996

# The magic of “rehab”

↓ LOAD:
- Resistive
- Elastic

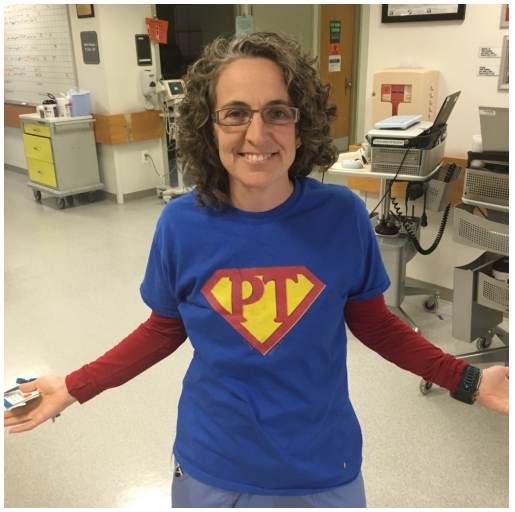
↑ CAPACITY

**Intensity of the load**

**Duration of Contraction**

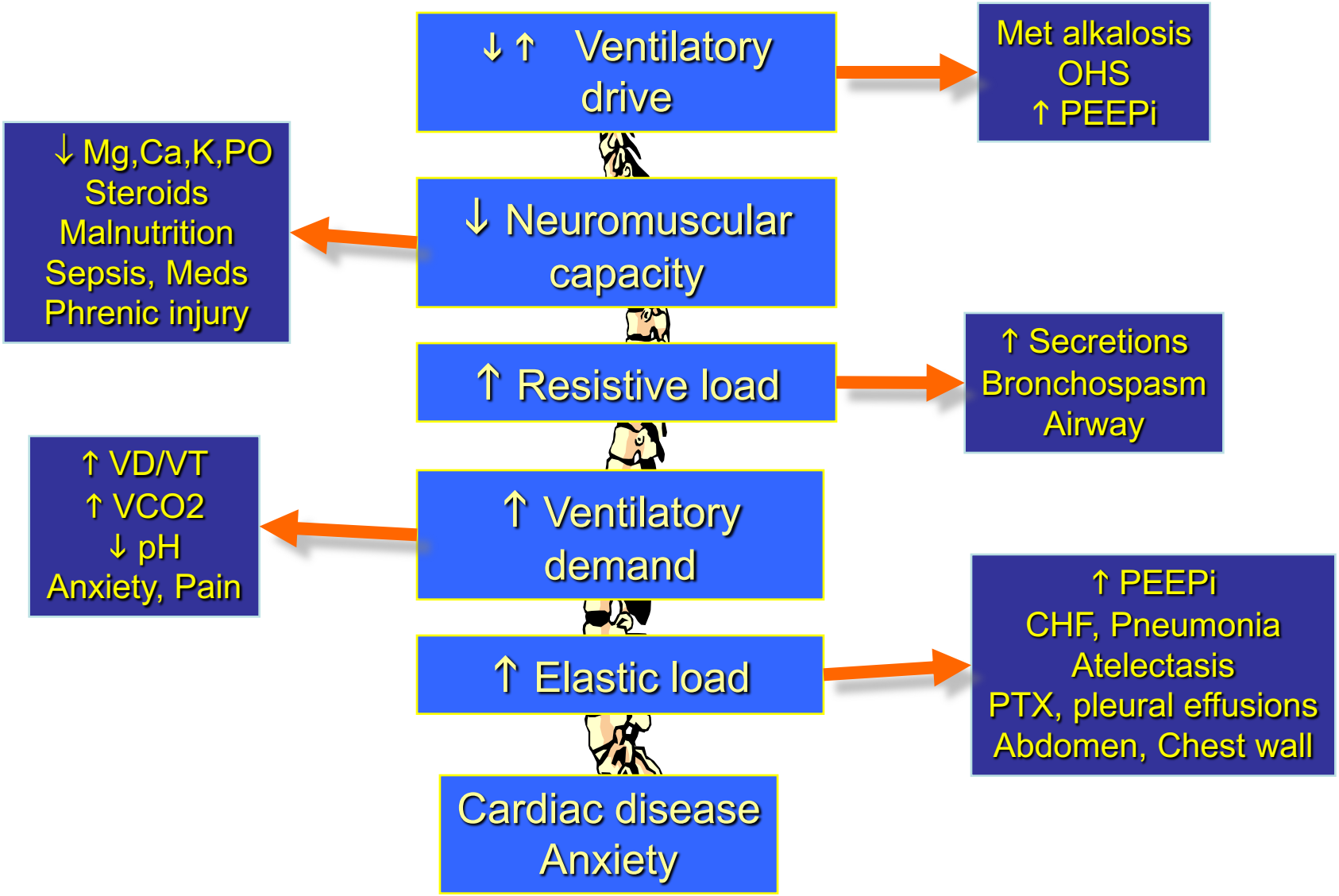
Purro, AJRCCM 2000 Bellemare, J. Appl. Physiol. 1982 Vassilakopoulos, Eur Resp J., 1996

# Increase Capacity: it takes a village!

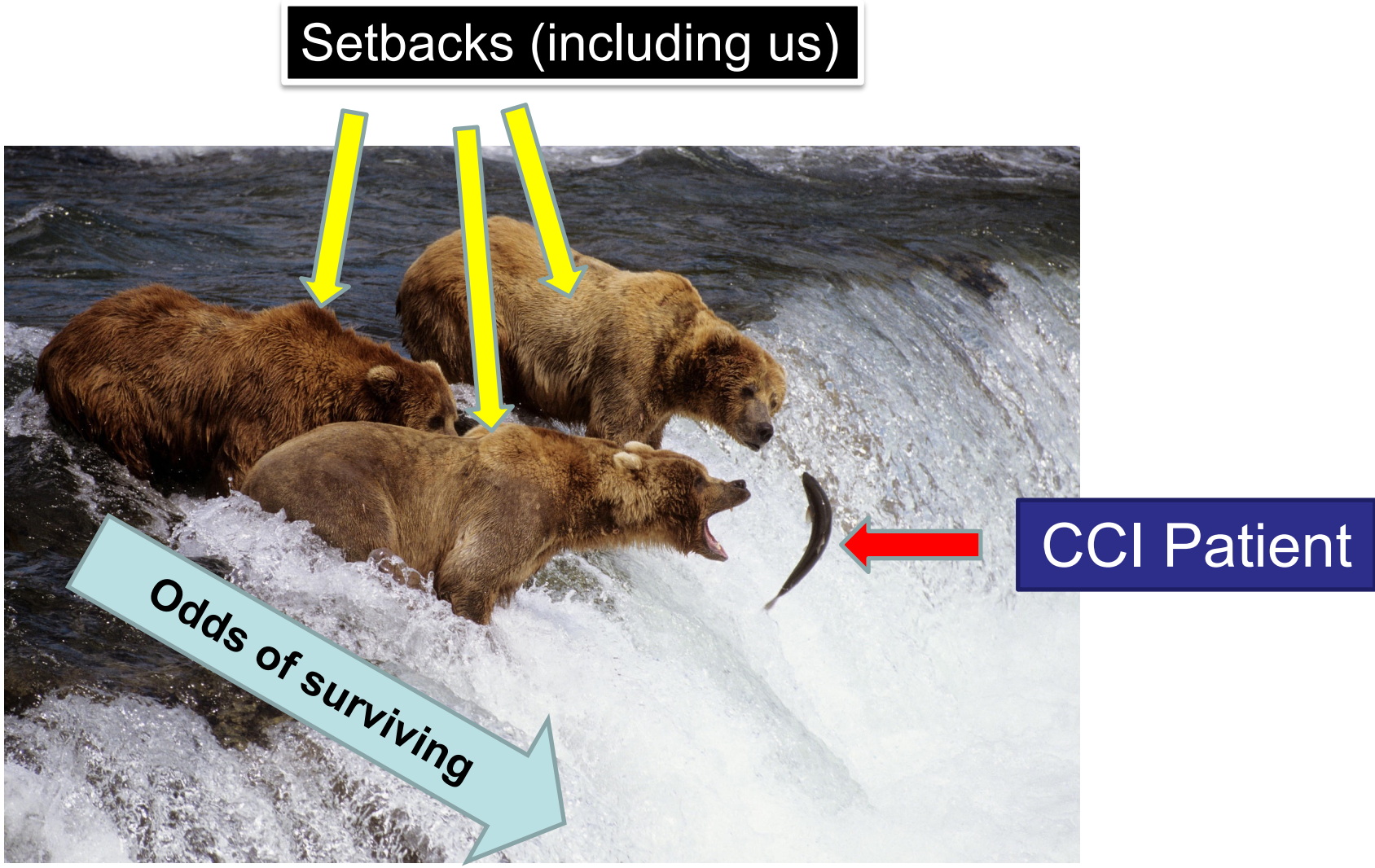



RT+ PT+ OT+ SLP+ RN= Superpower

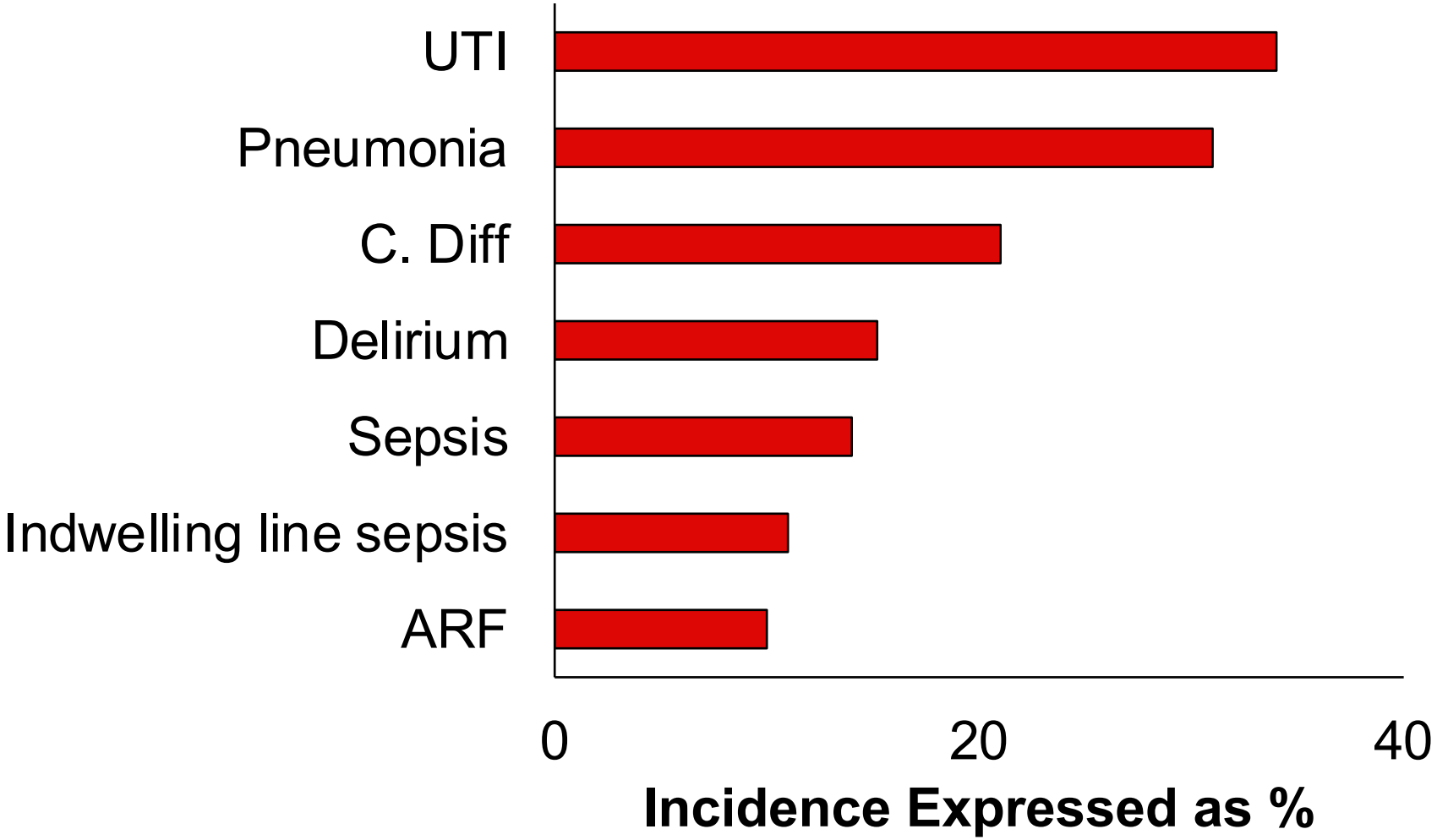
# Can we decrease the load?



# Setbacks….



# The 7 plagues: Deviation from the recovery process




DJ Scheinhorn et al Chest 2007
JE Nelson et al, Arch. Int. Med 2006

# Learning Points 2

1. Weaning is not just the mere action of removing the ventilator
2. Weaning is the systematic evaluation for the causes leading to respiratory failure and reverse them (if possible)

# Objectives

1. Epidemiology of the Chronic Respiratory Failure
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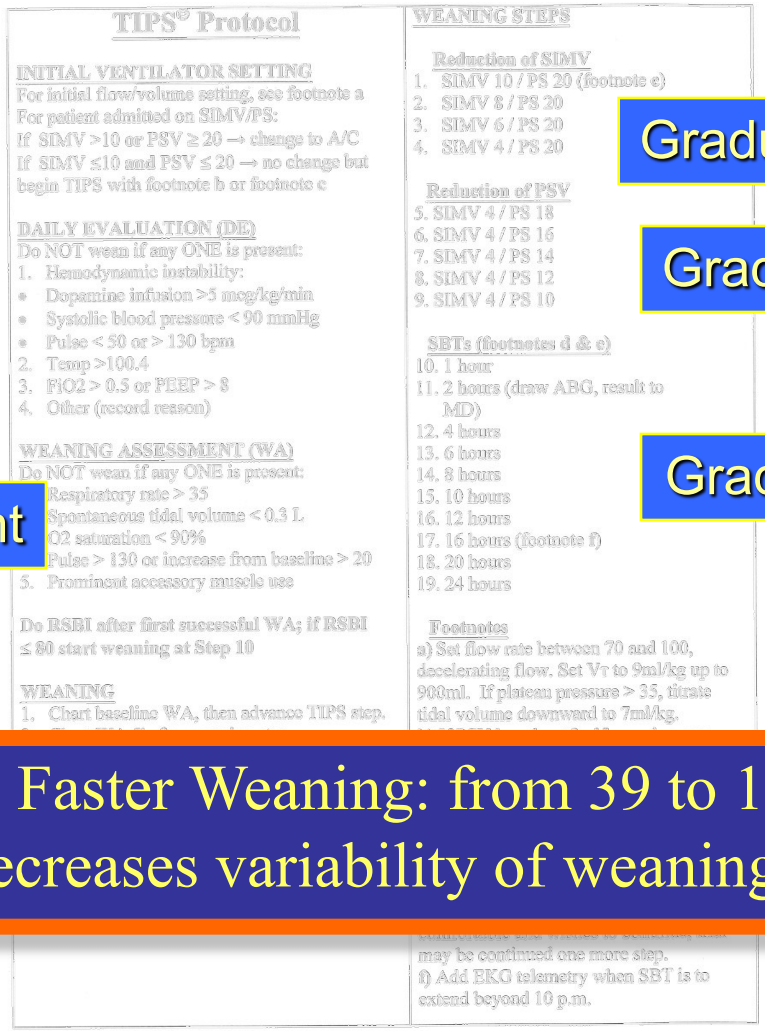
# Post-ICU Weaning Strategies

| Study | Decreasing Support | Increasing SBT |
|---|---|---|
| • Gracey ’98 | SIMV/PSV | TTO |
| • Petrak ’98 | ACV | VTM, PSV |
| • Bagley ’97 | ------ | VTM/TP |
| • Clark ’97 | PSV | VTM/TP |
| • Latriano ‘96 | SIMV/PSV | VTM/TP |
| • Scheinhorn ’94 | SIMV/PSV | VTM |

TTO= transtrach O2; VTM= Venturi mask; TP= T piece

# TIPS protocol for weaning patients from PMV



TIPS© Protocol

INITIAL VENTILATOR SETTING
For initial flow/volume setting, see footnote a
For patient admitted on SIMV/PS:
If SIMV >10 or PSV ≥ 20 → change to A/C
If SIMV ≤10 and PSV ≤ 20 → no change but begin TIPS with footnote b or footnote c

DAILY EVALUATION (DE)
Do NOT wean if any ONE is present:
1. Hemodynamic instability:
   - Dopamine infusion >5 mcg/kg/min
   - Systolic blood pressure < 90 mmHg
   - Pulse < 50 or > 130 bpm
2. Temp >100.4
3. FIO2 > 0.5 or PEEP > 8
4. Other (record reason)

WEANING ASSESSMENT (WA)
Do NOT wean if any ONE is present:
1. Respiratory rate > 35
2. Spontaneous tidal volume < 0.3 L
3. O2 saturation < 90%
4. Pulse > 130 or increase from baseline > 20
5. Prominent accessory muscle use

Do RSBI after first successful WA; if RSBI ≤ 80 start weaning at Step 10

WEANING
1. Chart baseline WA, then advance TIPS step.

WEANING STEPS

Reduction of SIMV
1. SIMV 10 / PS 20 (footnote e)
2. SIMV 8 / PS 20
3. SIMV 6 / PS 20
4. SIMV 4 / PS 20

Reduction of PSV
5. SIMV 4 / PS 18
6. SIMV 4 / PS 16
7. SIMV 4 / PS 14
8. SIMV 4 / PS 12
9. SIMV 4 / PS 10

SBTs (footnotes d & e)
10. 1 hour
11. 2 hours (draw ABG, result to MD)
12. 4 hours
13. 6 hours
14. 8 hours
15. 10 hours
16. 12 hours
17. 16 hours (footnote f)
18. 20 hours
19. 24 hours

Footnotes
a) Set flow rate between 70 and 100, decelerating flow. Set $V_T$ to 9ml/kg up to 900ml. If plateau pressure > 35, titrate tidal volume downward to 7ml/kg.
may be continued one more step.
f) Add EKG telemetry when SBT is to extend beyond 10 p.m.

Daily Evaluation

Weaning Assessment

Gradual Reduction SIMV Rate

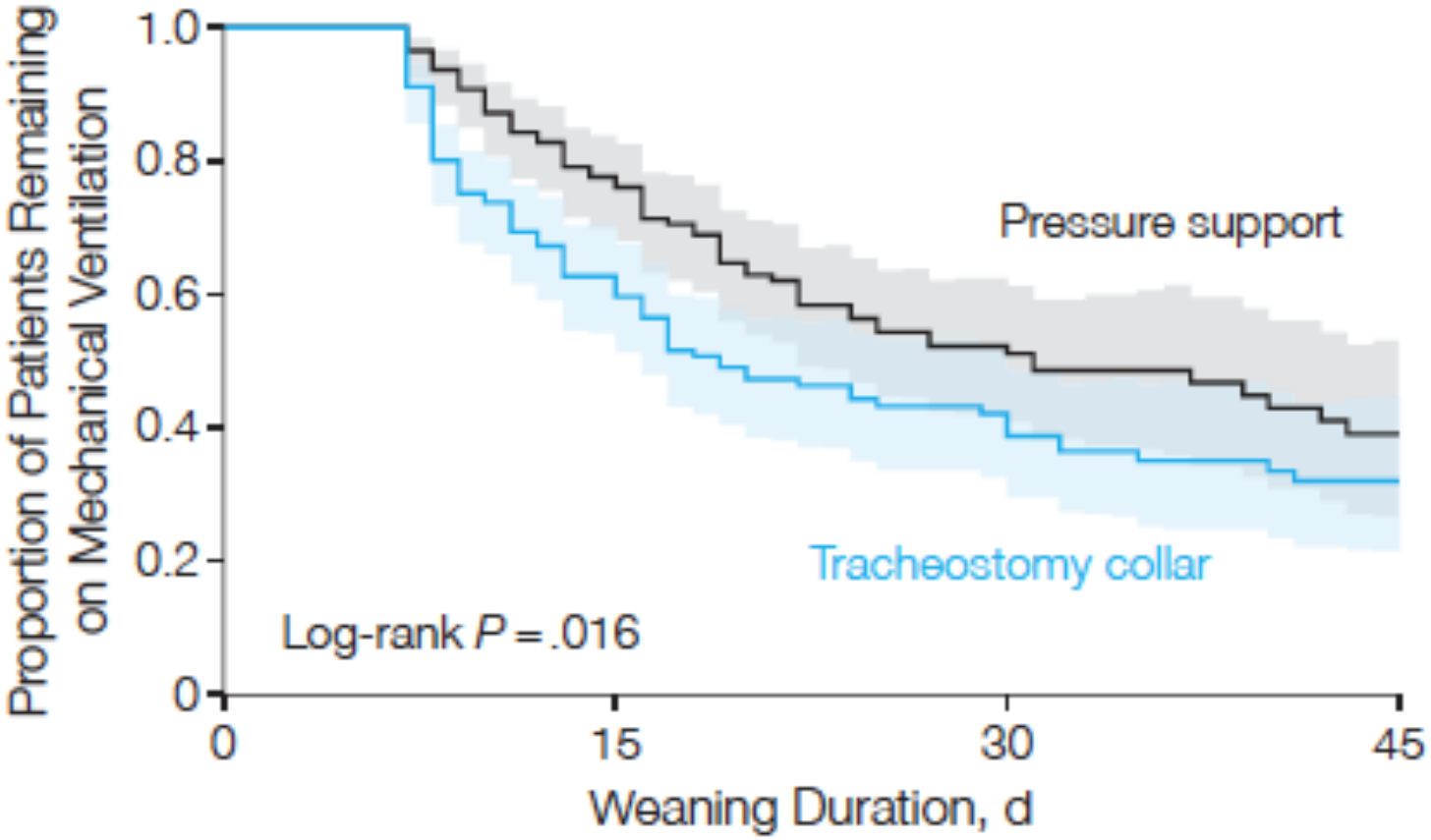
Gradual Reduction PSV

Gradual Increments SBTs

Faster Weaning: from 39 to 17 Days
Decreases variability of weaning practices

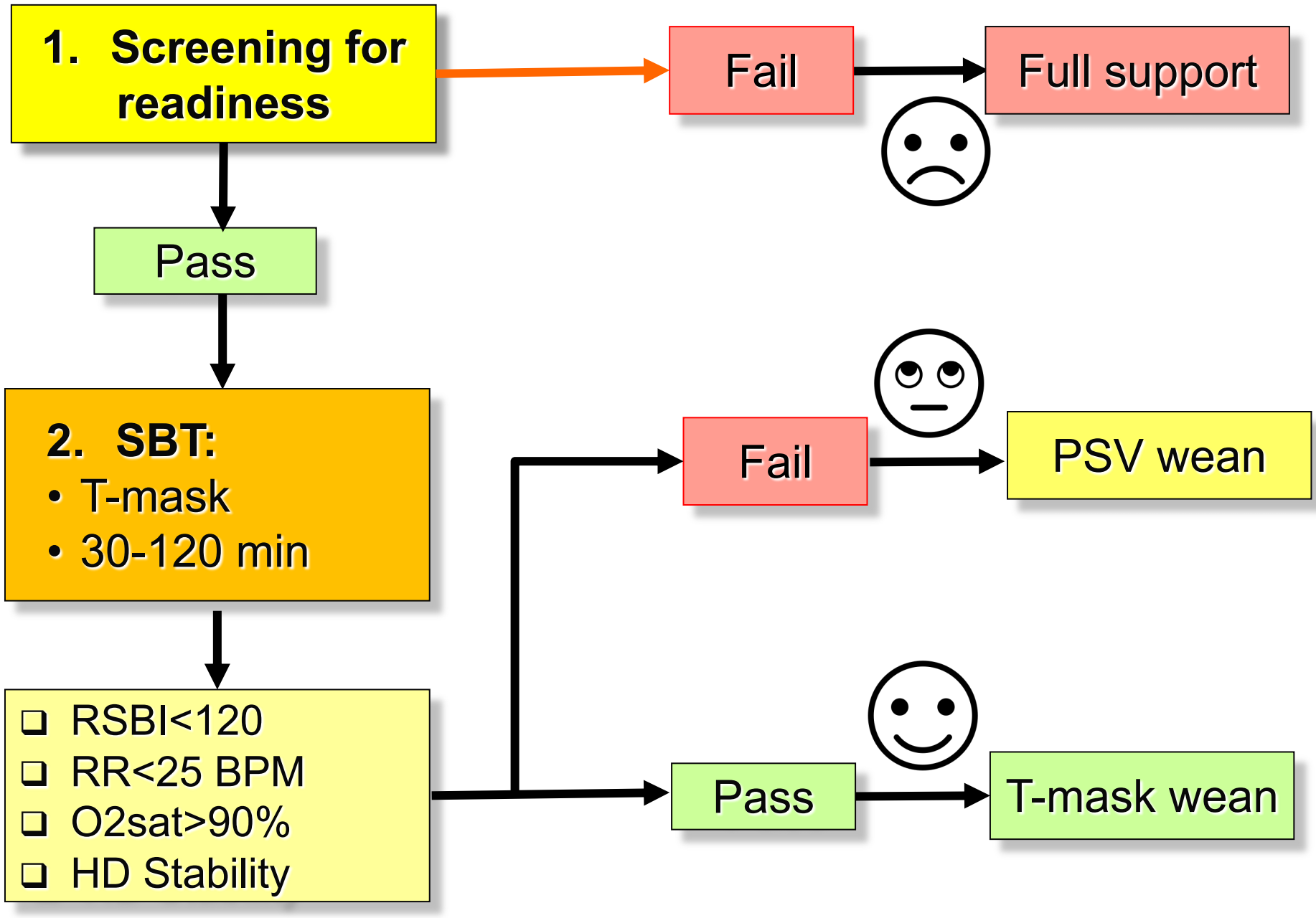
Scheinhorn, D. J. et al. Chest 2001;119:236-242

# PSV or T-mask?

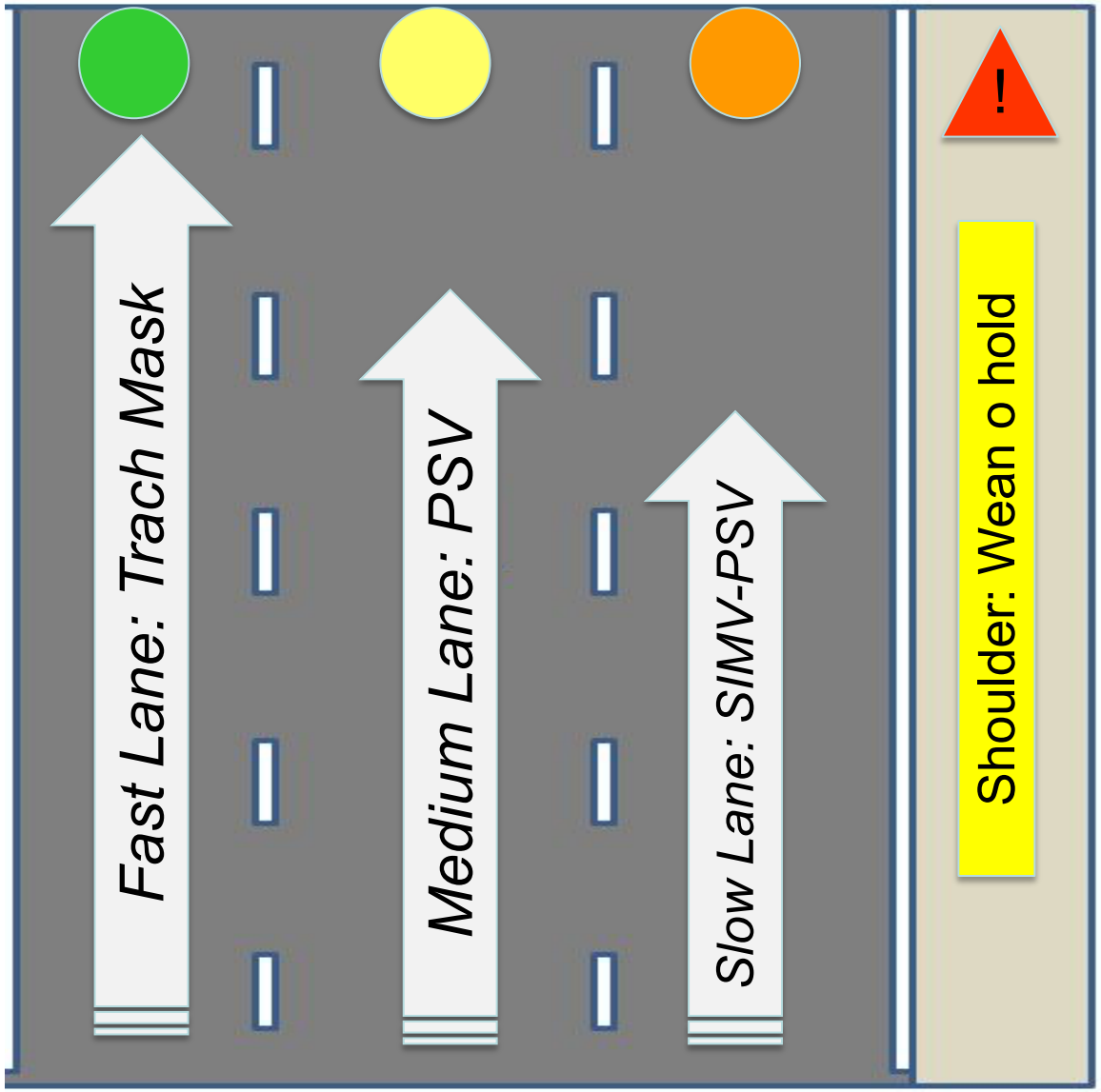



Jubran A, et al. *JAMA* 2013;309:671–677.

# How to choose?



# Weaning Strategy Highway



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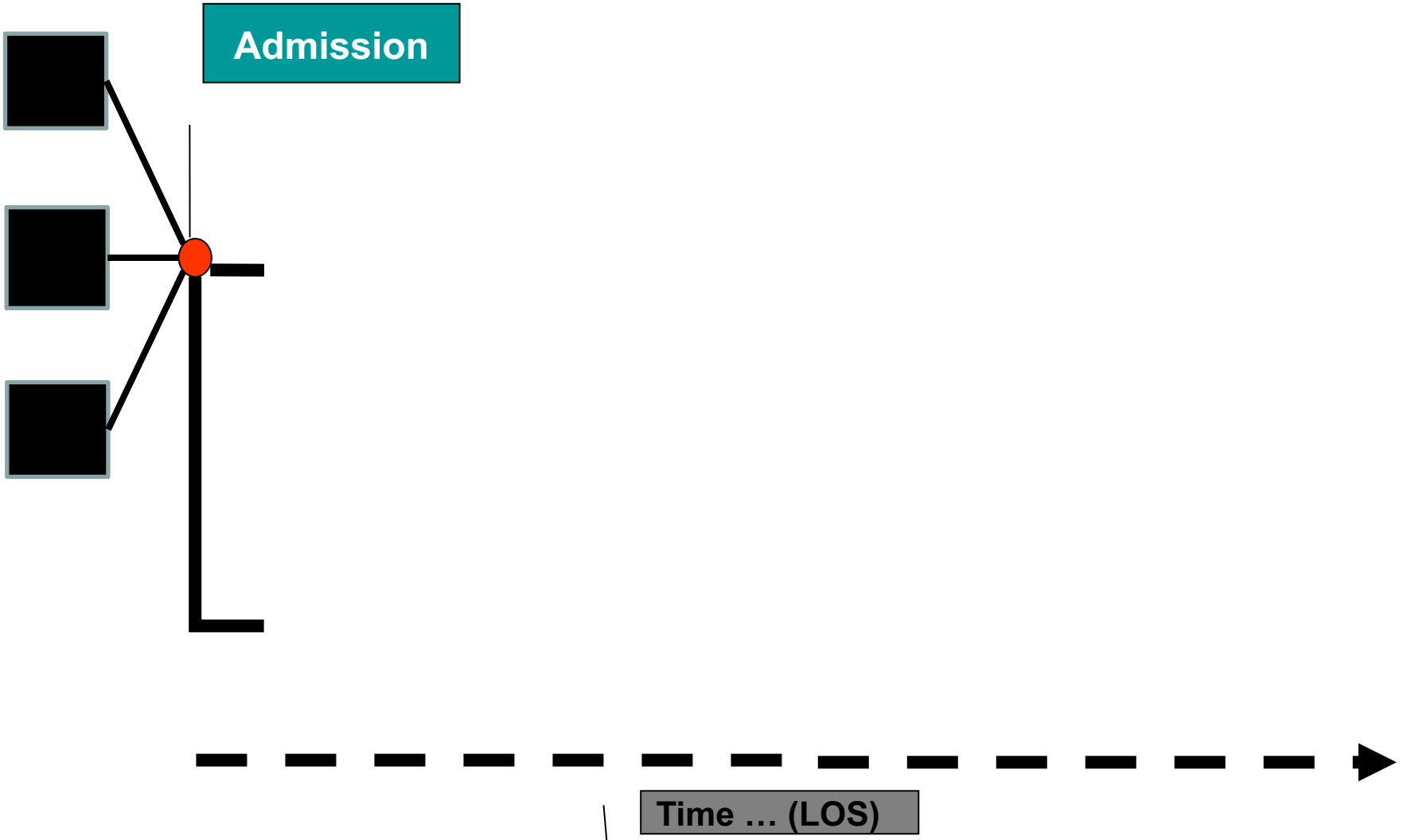
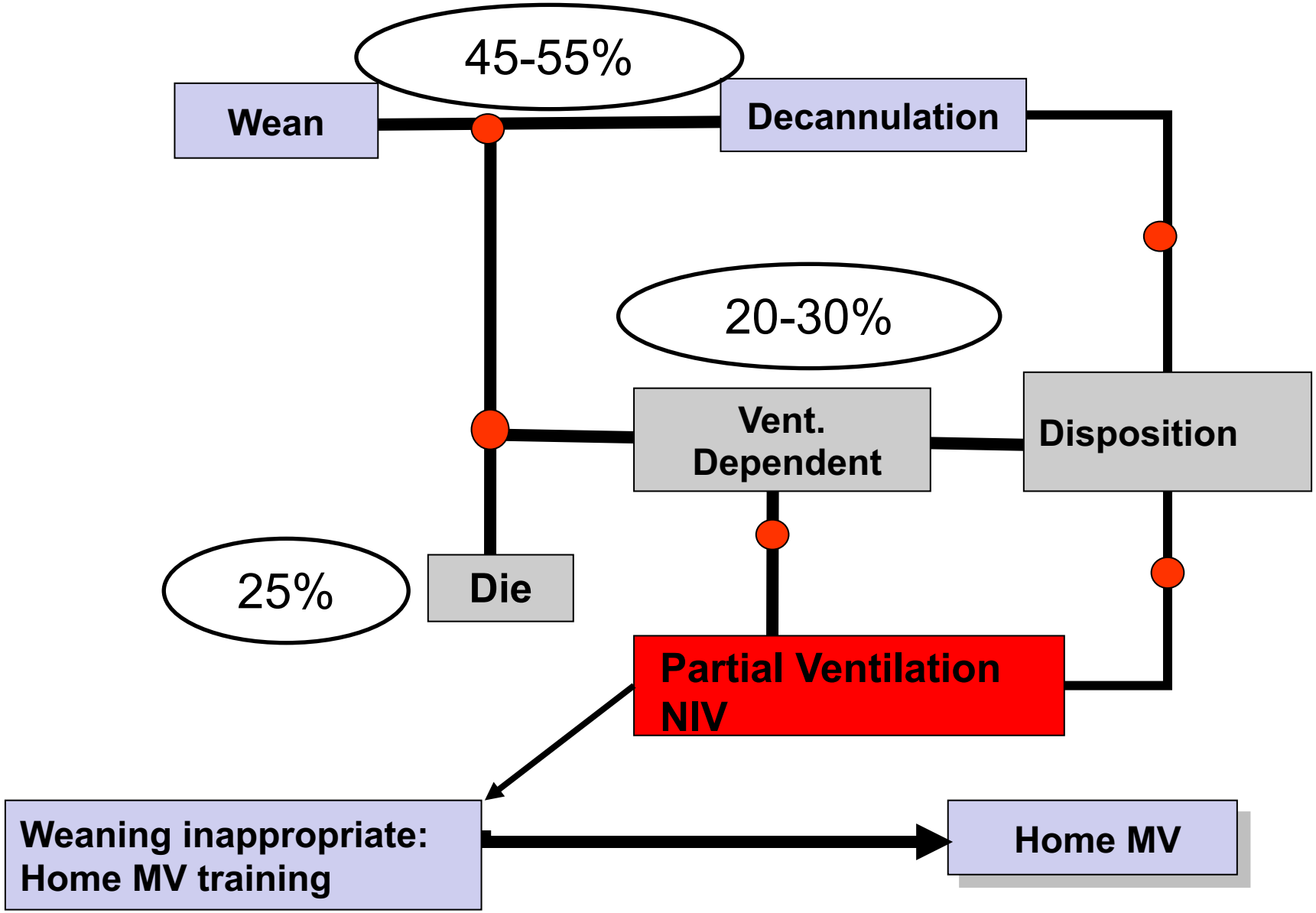
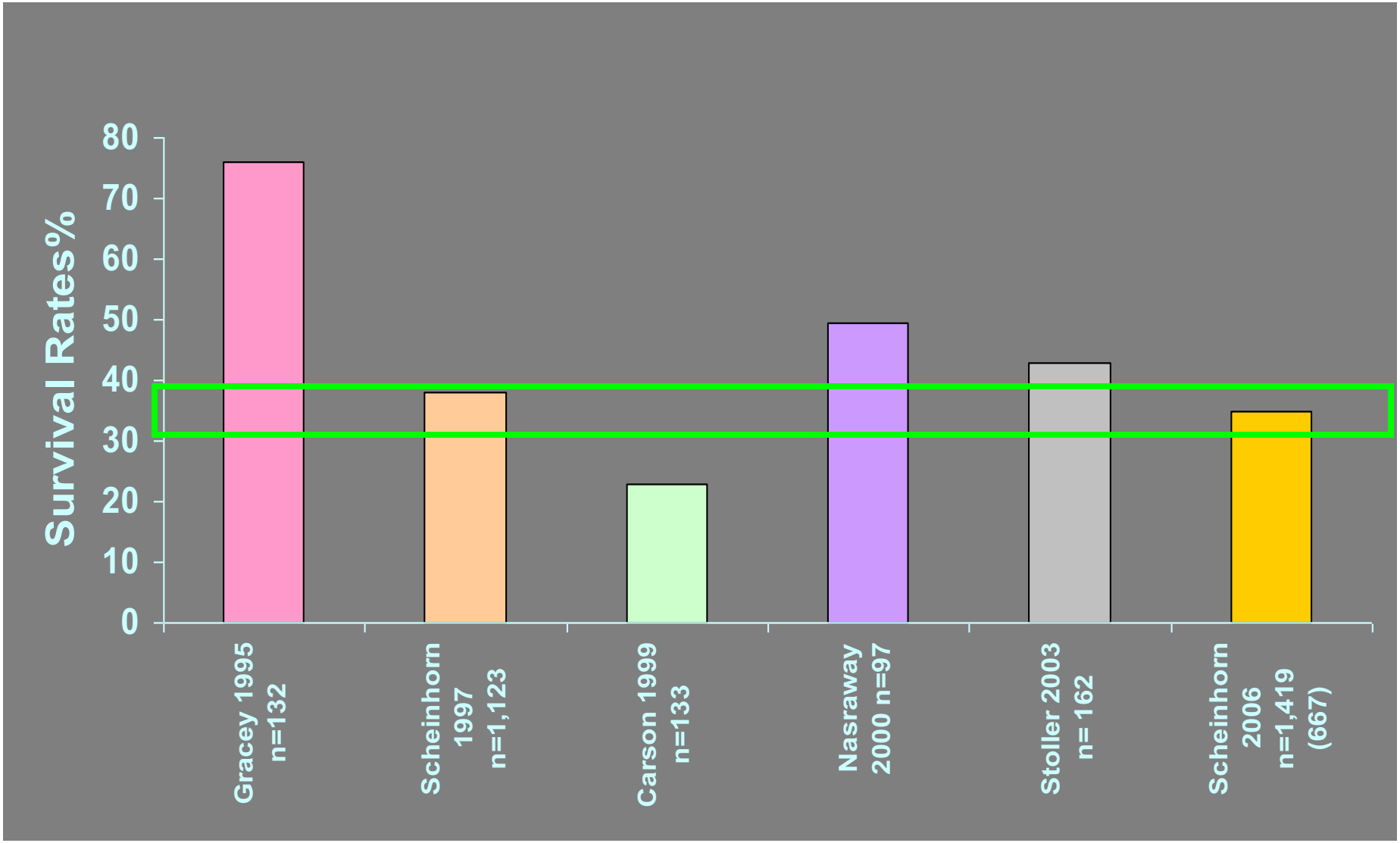
# Mapping the mechanical ventilation weaning process



# Mapping the mechanical ventilation weaning process



# Reality: One year survival rate





Gracey DR, et al, CHEST 1995; 107:494-499
Carson SS, et al AJRCCM 1999; 159:1568-1573
Scheinhorn D, et al, CHEST 2007
Scheinhorn DJ, et al, CHEST 1997; 111:1654-1659
Nasraway SA, et al CCM 2000; 28: 19-25
Stoler J, et al, 2003; 124: 1892-1899

# Conclusions

- Weaning is a collaborative process
- Physician should identify and when possible, treat reversible causes of weaning failure
- Weaning is more than the transfer of effort from the machine to the patient
- Para-medical personnel are the key to make the plan work
- More research and multi-specialty collaboration is needed

# Question

- A 73 y/o patient is admitted to LTACH from the ICU, on mechanical ventilation via tracheostomy tube. Patient failed extubation attempt in the ICU, thus the decision for tracheostomy. The reason for his ICU admission was COVID-19 ARDS.
- Upon arrival patient passed screening for SBT, and was placed on trach-mask for 45 min and resulted: RSBI 145, RR 36 BPM and O2 sat 94%

# Question

Based on the SBT results, should this patient be :

A. Initiate weaning plan on SIMV-PS with incremental increase in SIMV
B. Incremental T-mask trials
C. PSV trials with incremental time and sequential decrease in PS
D. Deem the patient as unweanable

# Answer

Based on the SBT results, should this patient be :

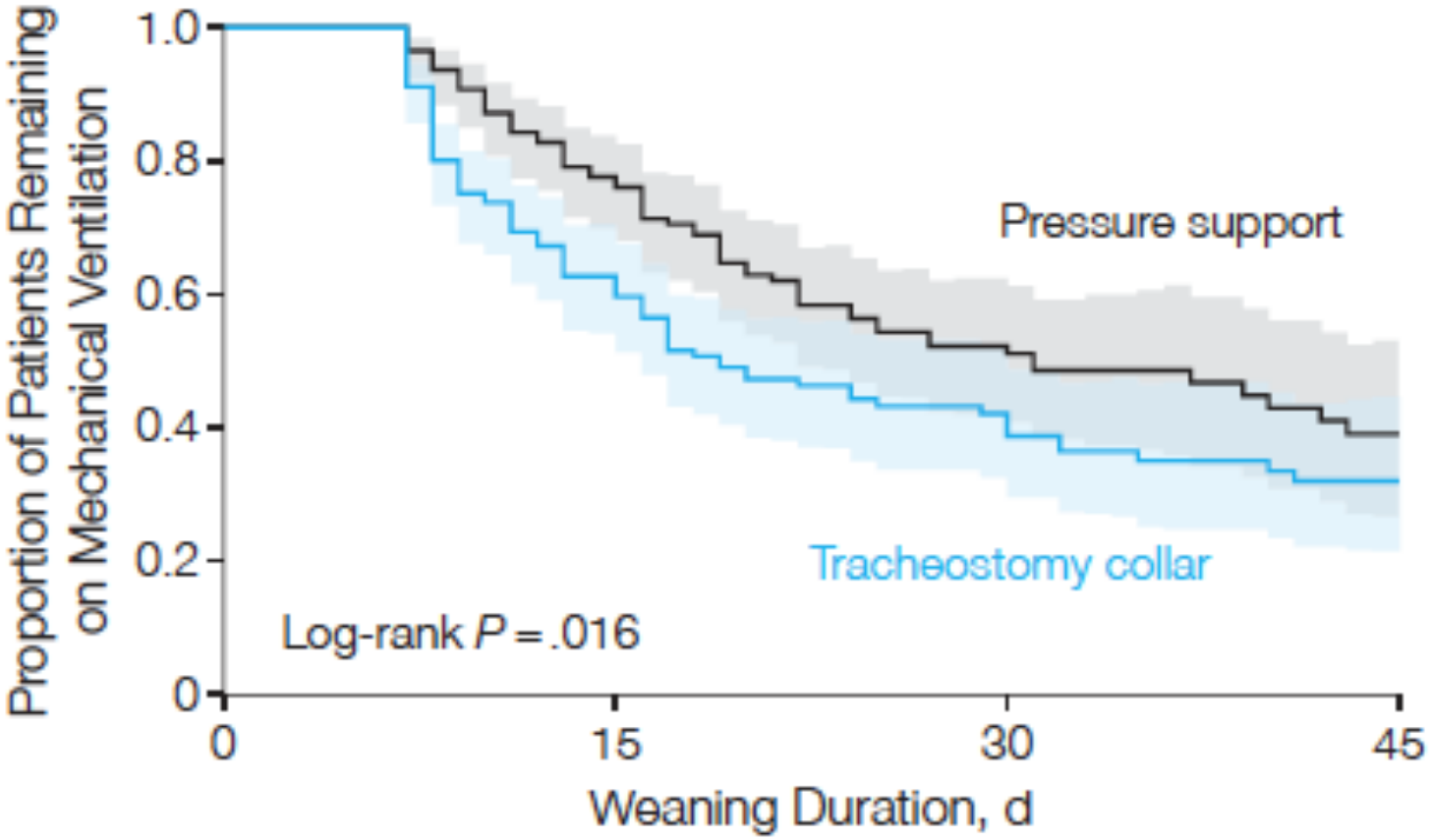
A. Initiate weaning plan on SIMV-PS with incremental increase in SIMV

B. Incremental T-mask trials

**C. PSV trials with incremental time and sequential decrease in PS**

D. Deem the patient as unweanable

# Answer: PSV

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