Keynote - The Post-Intensive Care Syndrome: Intensive Care Beyond the Unit

Terri Hough, MD
Professor
Oregon Health & Science University

Dr. Hough grew up in California, receiving her BA at the University of California, Berkeley and her MD at the University of California, San Francisco. After completing Internal Medicine residency in Philadelphia at the University of Pennsylvania, she returned to the West Coast to the University of Washington, where she trained as a clinical and research fellow in Pulmonary and Critical Care Medicine and received an MS in Epidemiology. Dr. Hough remained at UW for over twenty years, studying outcomes for patients with the acute respiratory distress syndrome and other critical illnesses, using clinical trials, observational epidemiology, and translational methods and implementation science. Now as Professor and Chair of Medicine at the Oregon Health & Science University, Dr. Hough leads multiple investigations funded by the NIH, American Lung Association, and the Centers for Disease Control. Supported by an NHLBI K24 award and PI of OHSU's NCATS-funded KL2 Program, she is recognized for her ongoing dedication to mentoring the next generation of clinician-scientists who are committed to improving post-hospital patient-important outcomes.

She is also active nationally, in research collaboratives and in the American Thoracic Society, where she is the chair of the Critical Care Assembly. Dr. Hough is delighted to return to home to join the California Thoracic Society's annual meeting in March 2024.

Understanding and improving outcomes after critical illness

California Thoracic Society
Annual Meeting and Educational Conference
Monterey, CA
March 9th, 2024

Catherine "Terri" Hough, MD, MSc, ATSF
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Disclosures

Questions to address

- What are the long-term sequelae after critical illness?
- Which patients are at high risk for post-ICU impairment?
- How can we improve outcomes?

Case presentation

ID: 30 year old man

CC: Altered mental status

HPI: Febrile for several days, sleeping most of time.
Progressively tachypneic, somnolent
Productive cough
Roommate also recently sick

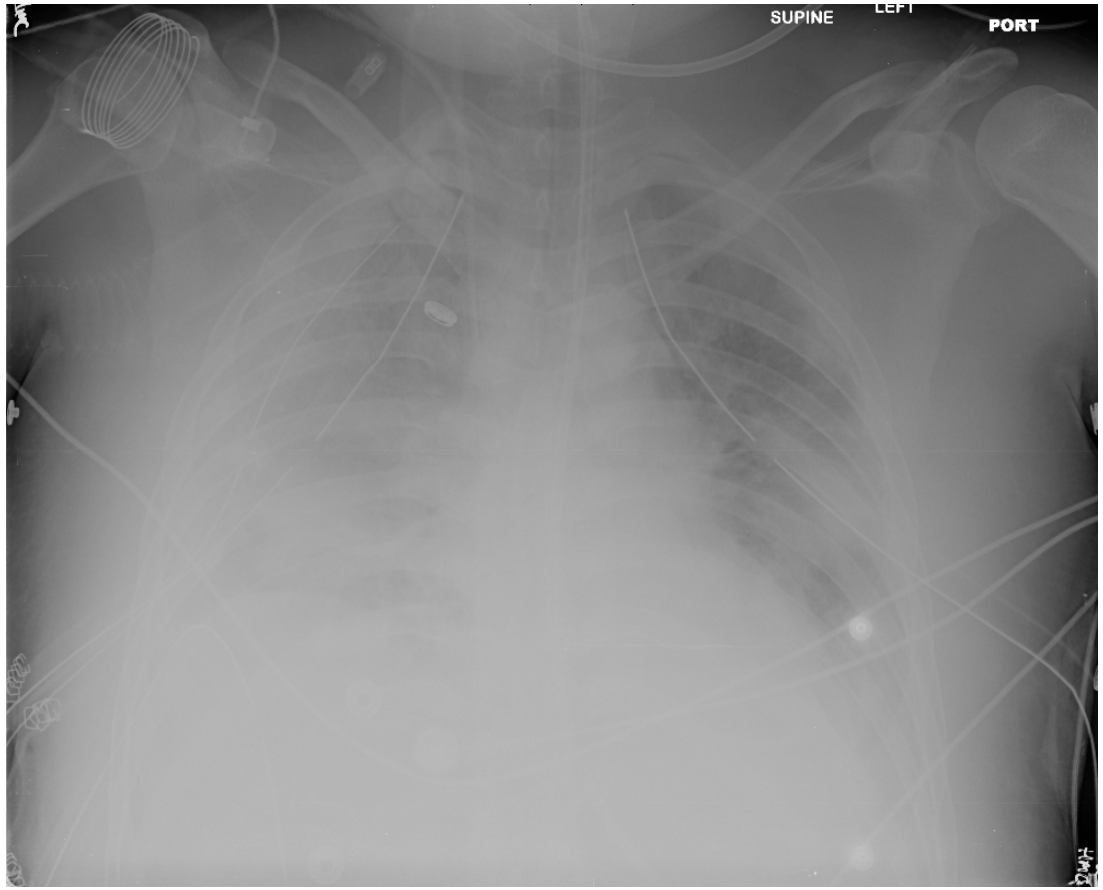
PMH: Mild asthma

No medications, allergies, or relevant family history

Social History: Full time dog wrangler
Rents a basement apartment with friends
Non-smoker
Occasional alcohol use, no drug use

"Wrangler"
www.howimetmydog.com

- Initial findings
  - Hypotension
  - Hypoxemic respiratory failure
  - Acute kidney injury
  - Bilateral infiltrates and pleural effusions
- Management
  - Empiric antibiotics
  - Intubated and mechanically ventilated
  - Received fluids and vasopressors for shock
  - Bilateral tube thoracostomy
- Diagnoses
  - Septic shock with multiple organ dysfunction
  - Acute respiratory distress syndrome
  - MRSA pneumonia, empyema, bacteremia



Month 1

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Admit	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

Month 2

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49
50						

- Day 27: liberated from mechanical ventilation

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Month 1

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Admit	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

Month 2

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49
50						

- Day 29: transferred out of ICU

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Month 1

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Admit	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

Month 2

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49
50						

- Day 50: Discharged home

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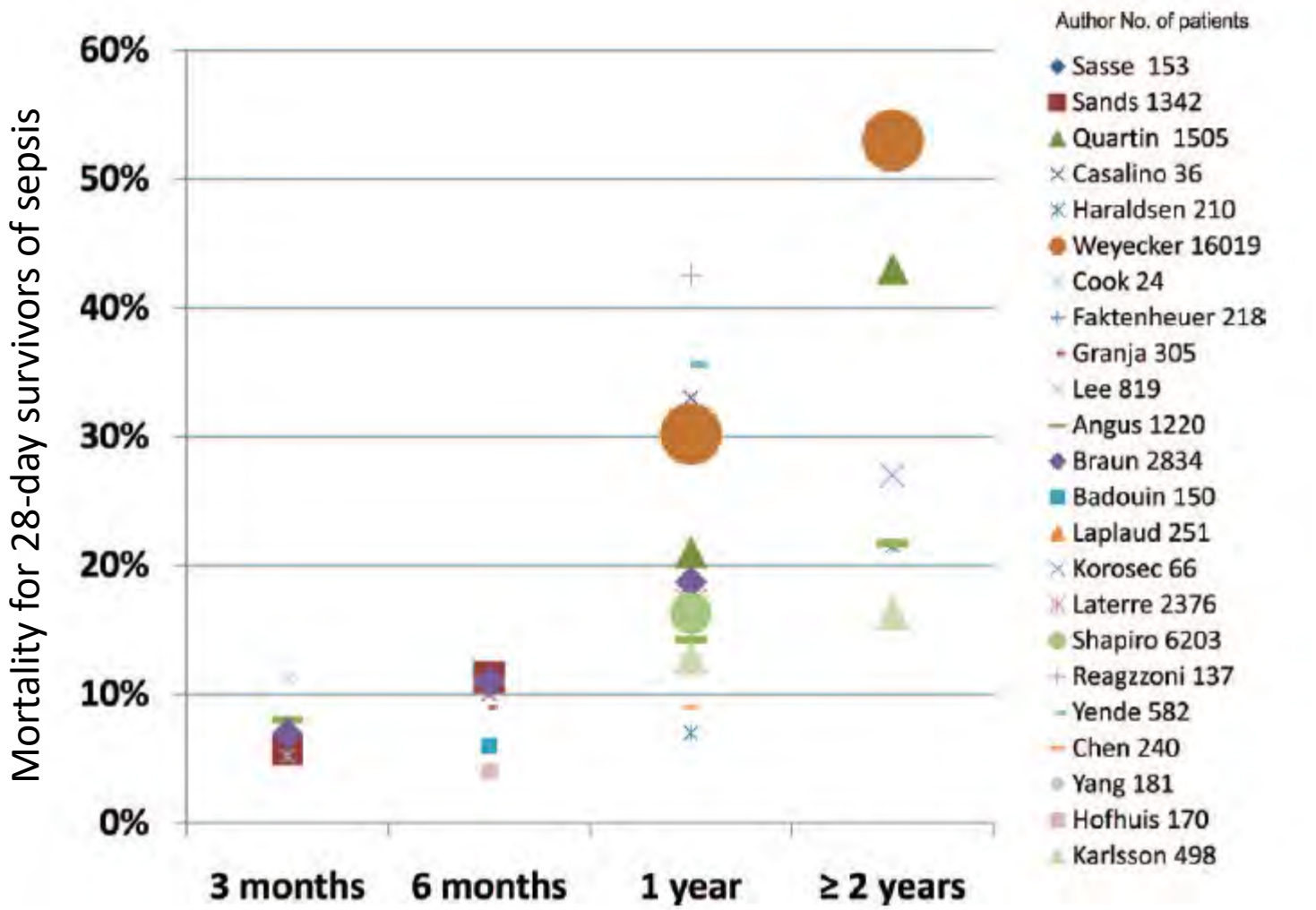
He survived hospitalization.
But is he better?

Status at hospital discharge

Questions to address

- What are the long-term sequelae after critical illness?
- Which patients are at high risk for post-ICU impairment?
- How can we improve outcomes?

Mortality risk remains high



Winters BD. *CCM* 2010

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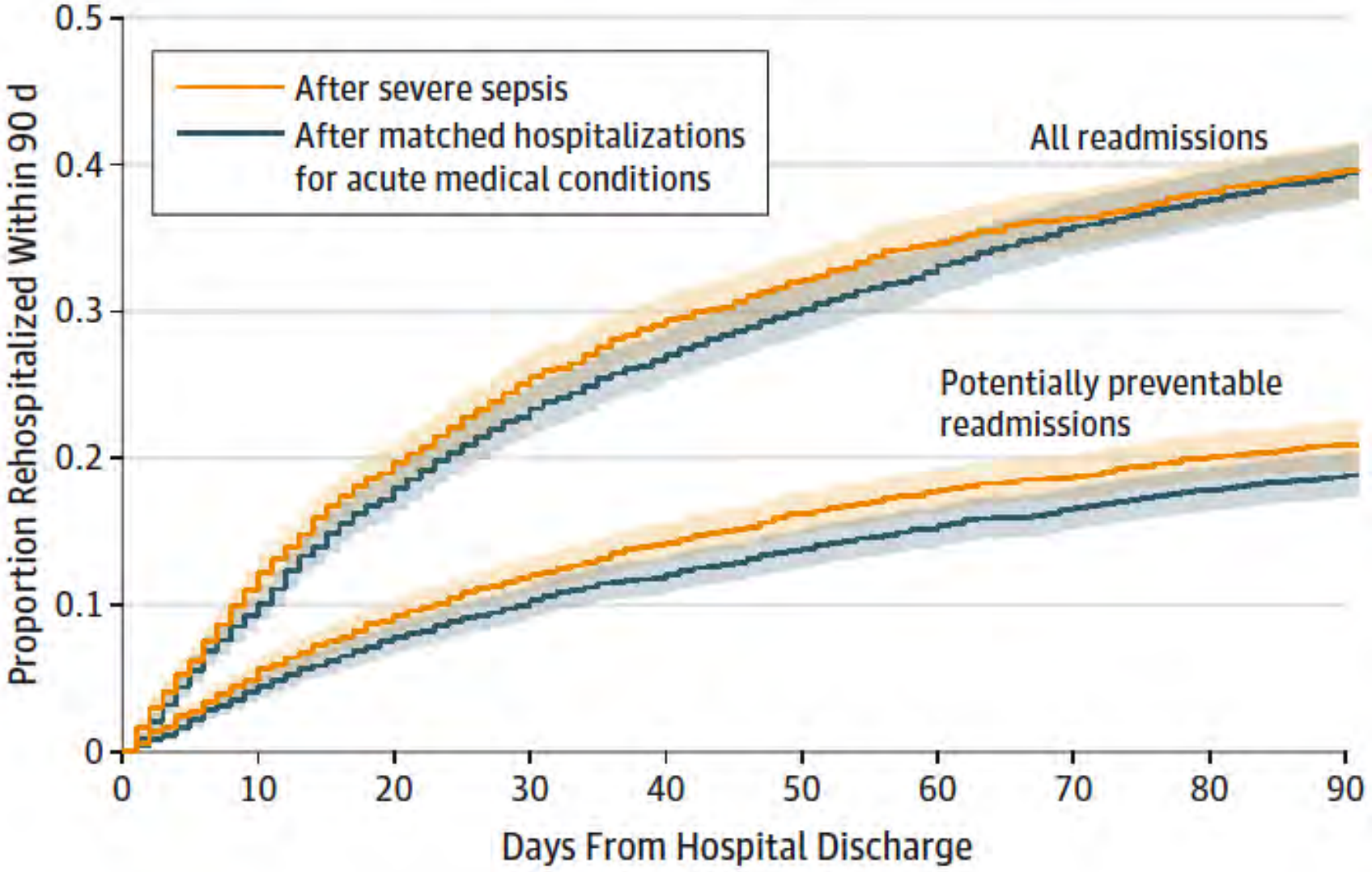
After severe sepsis
After matched hospitalizations for acute medical conditions
All readmissions
Potentially preventable readmissions
Proportion Rehospitalized Within 90 d
0.5
0.4
0.3
0.2
0.1
0
0
10
20
30
40
50
60
70
80
90
Days From Hospital Discharge

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Pulmonary function normalizes over time

Variable	3 Mo (N=71)*	6 Mo (N=77)†	12 Mo (N=80)‡
	median (interquartile range)		
Forced vital capacity (% of predicted)	72 (57–86)	80 (68–94)	85 (71–98)
Forced expiratory volume in one second (% of predicted)	75 (58–92)	85 (69–98)	86 (74–100)
Total lung capacity (% of predicted)§	92 (77–97)	92 (83–101)	95 (81–103)
Residual volume (% of predicted)§	107 (87–121)	97 (82–117)	105 (90–116)
Carbon monoxide diffusion capacity (% of predicted)§¶	63 (54–77)	70 (58–82)	72 (61–86)

Herridge *et al NEJM* 2003

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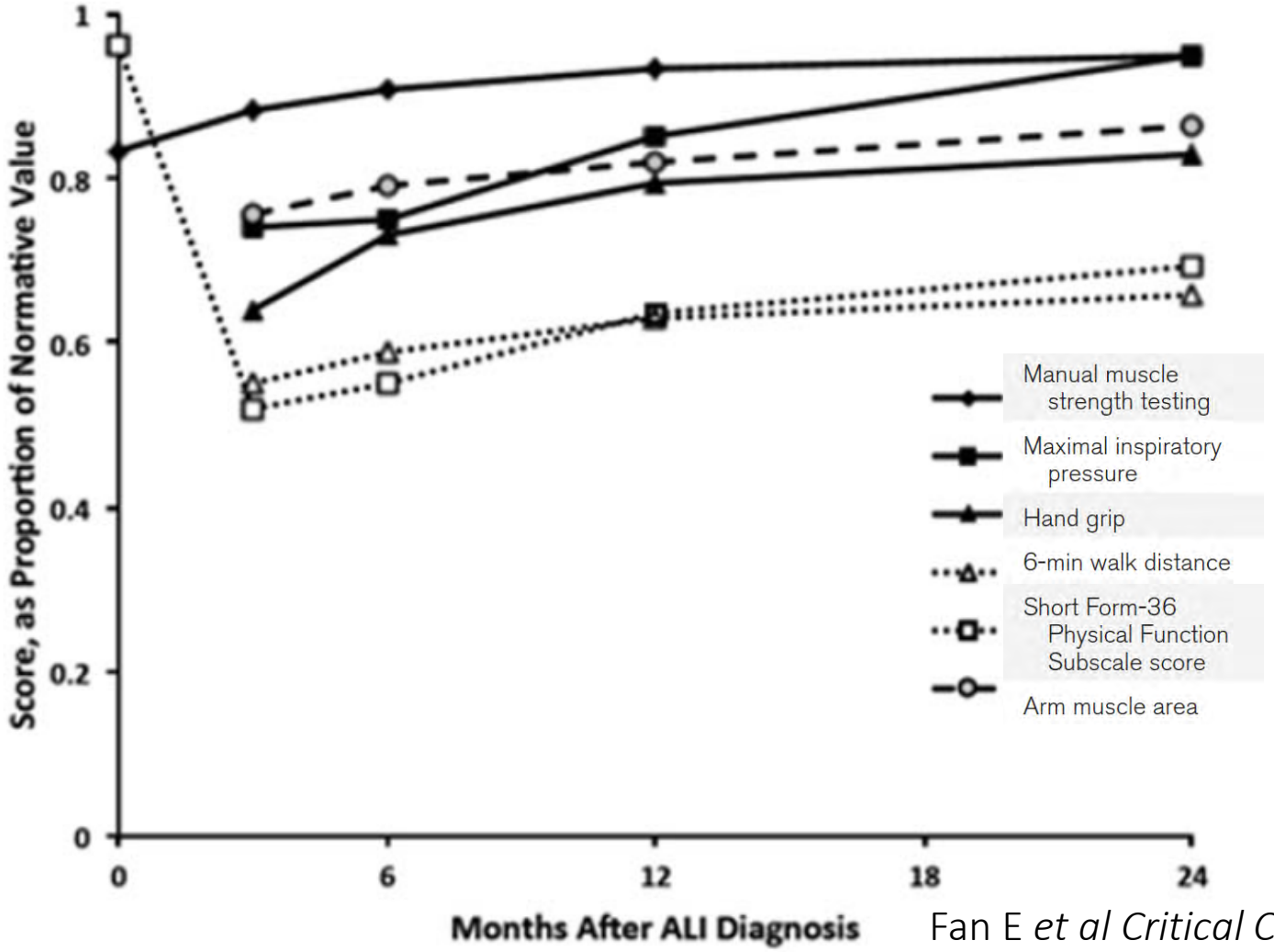
Weakness generally resolves, but physical functional impairment persists



Fan E *et al Critical Care Medicine* 2013

Gradual recovery of weight, but not muscle

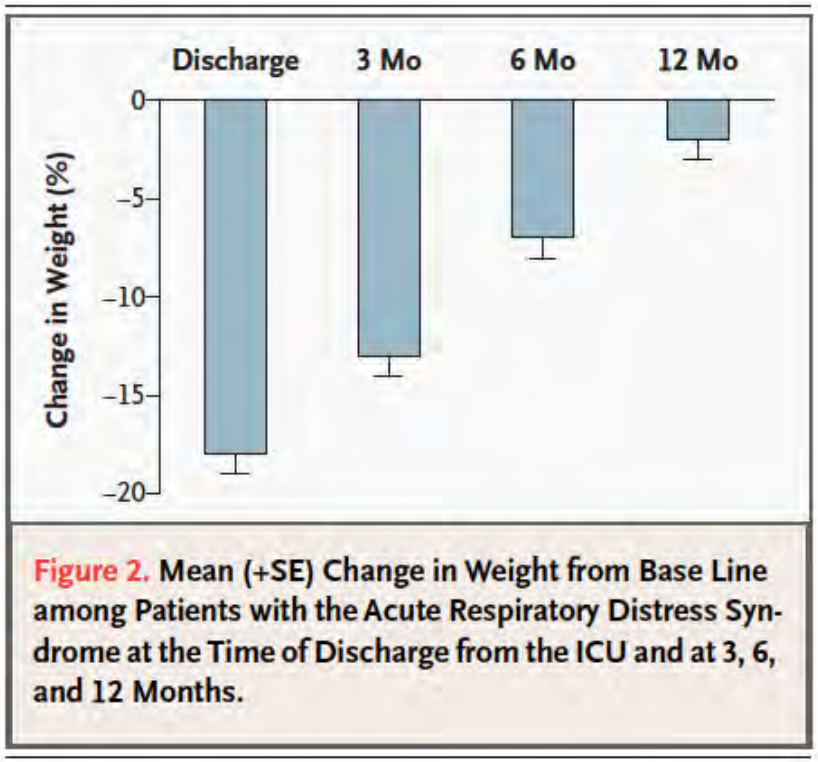
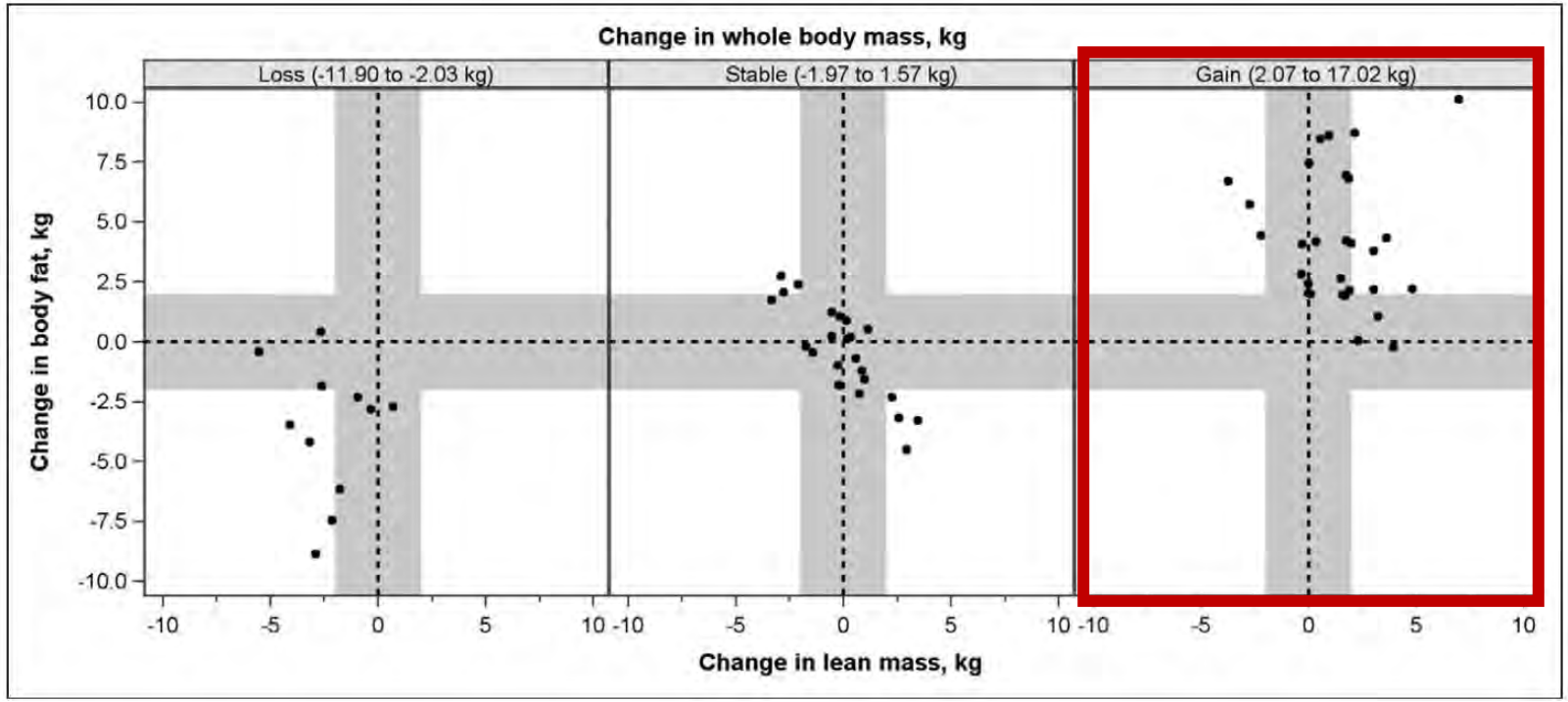


Figure 2. Mean (+SE) Change in Weight from Base Line among Patients with the Acute Respiratory Distress Syndrome at the Time of Discharge from the ICU and at 3, 6, and 12 Months.



Herridge *et al NEJM* 2003
Chan KS *et al Critical Care Med* 2018

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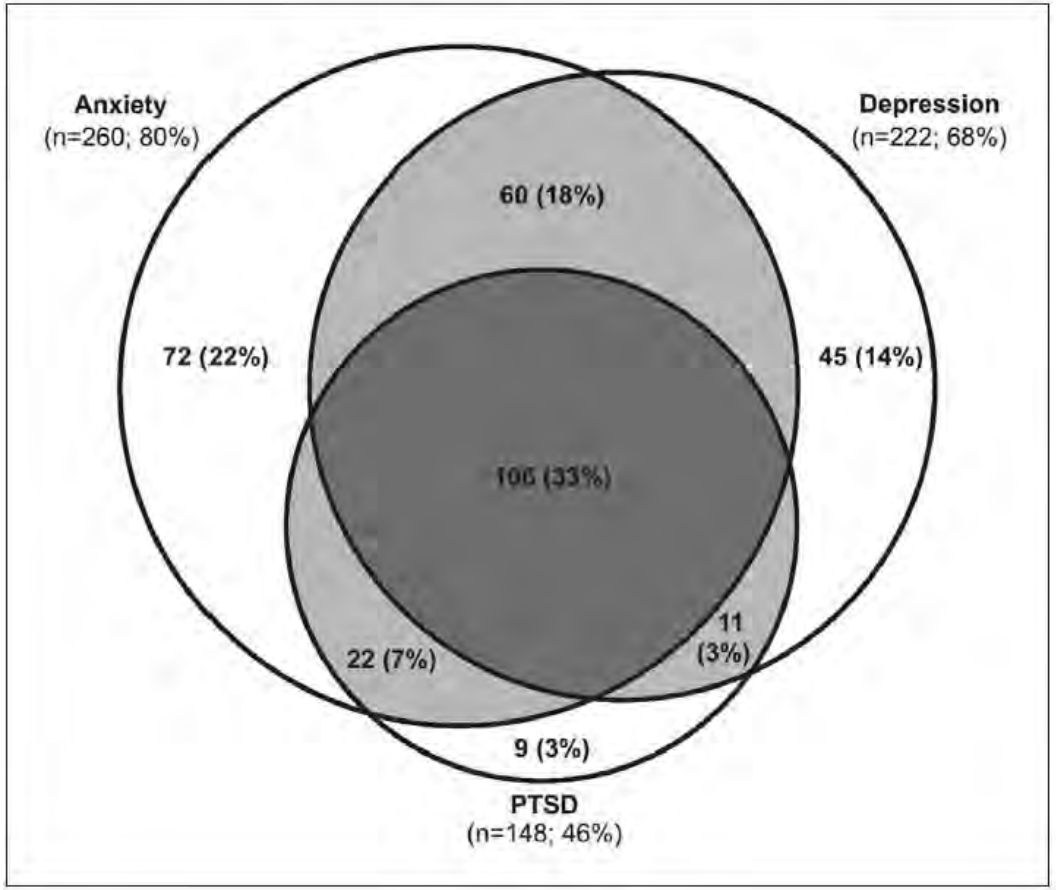
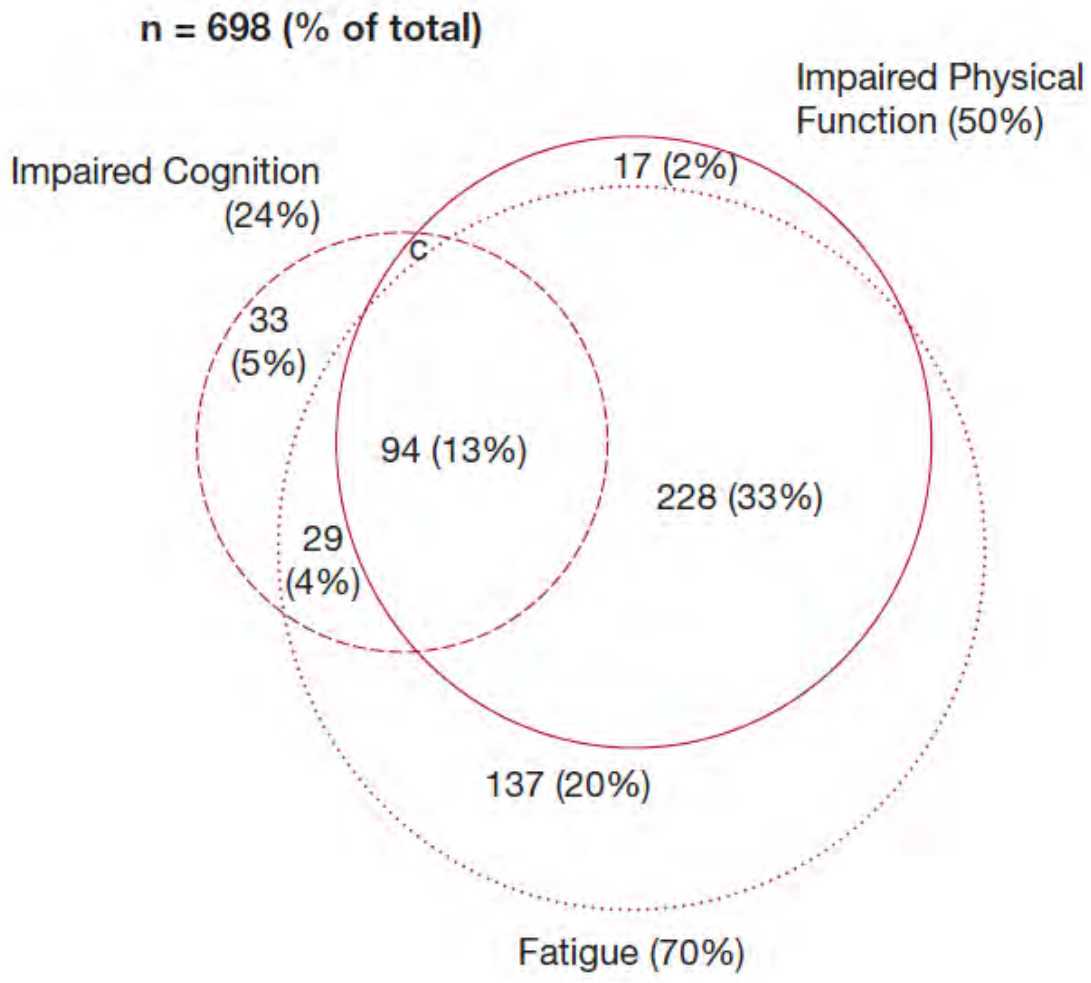
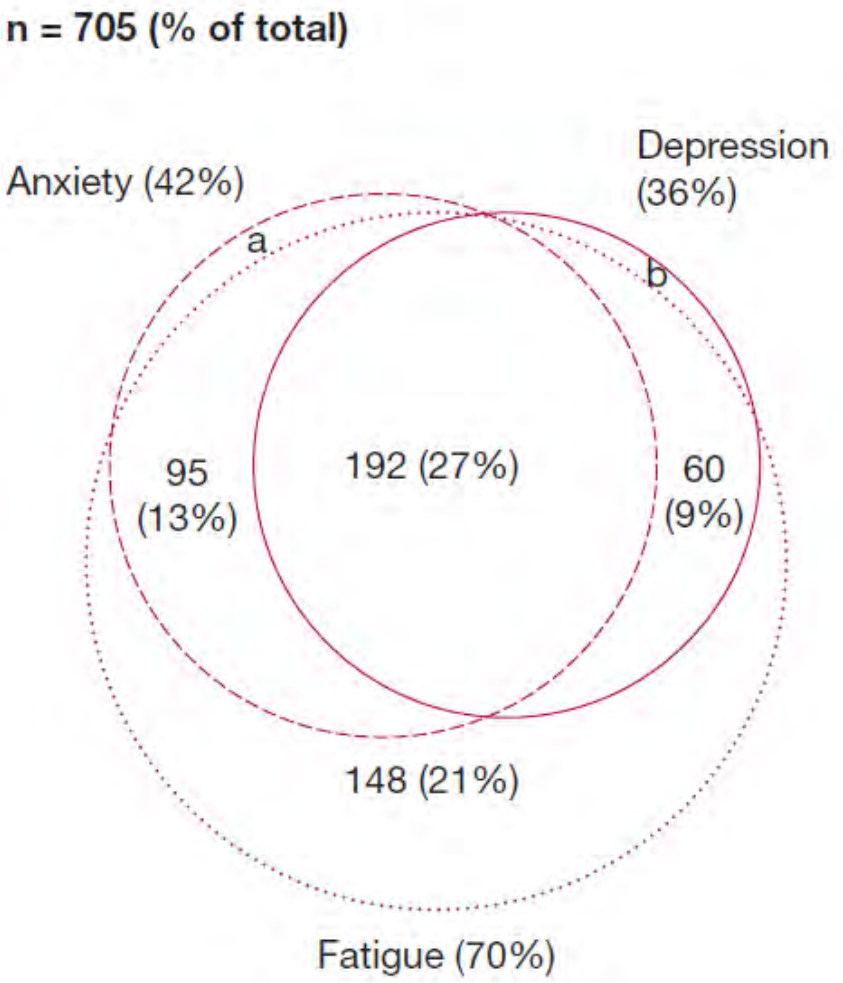
Most have persistent mental health impairment

- 66% of ARDS survivors at 6-12 months (n=629)
  - Depressive: 36%
  - Anxiety: 42%
  - Post-traumatic stress: 24%
  - Many with multiple domains



Huang M. *CCM* 2016


n = 698 (% of total)
Impaired Physical Function (50%)
Impaired Cognition (24%)
17 (2%)
c
33 (5%)
94 (13%)
228 (33%)
29 (4%)
137 (20%)
Fatigue (70%)


n = 705 (% of total)
Anxiety (42%)
Depression (36%)
a
b
95 (13%)
192 (27%)
60 (9%)
148 (21%)
Fatigue (70%)

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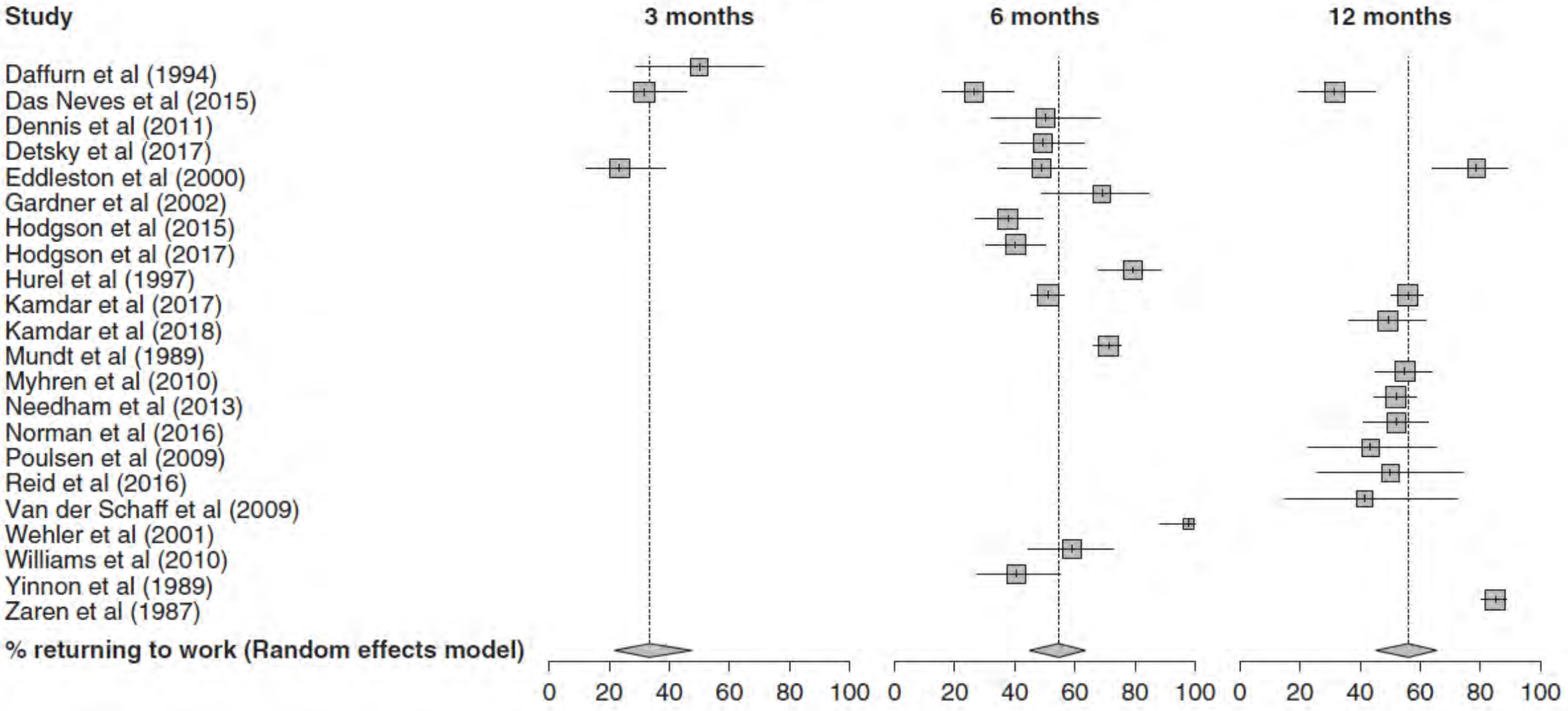
Only half return to work within a year



McPeake J. *Annals ATS* 2019

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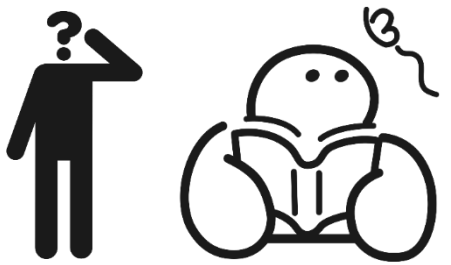
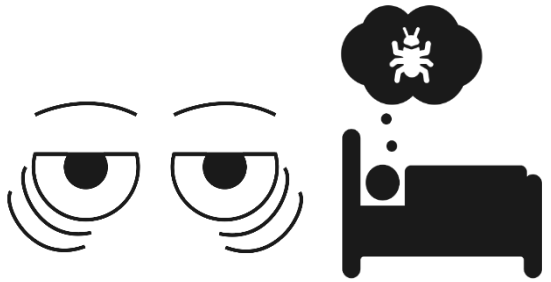
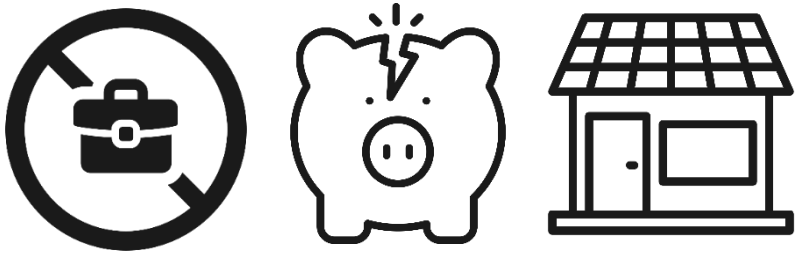
Status: 6 months later

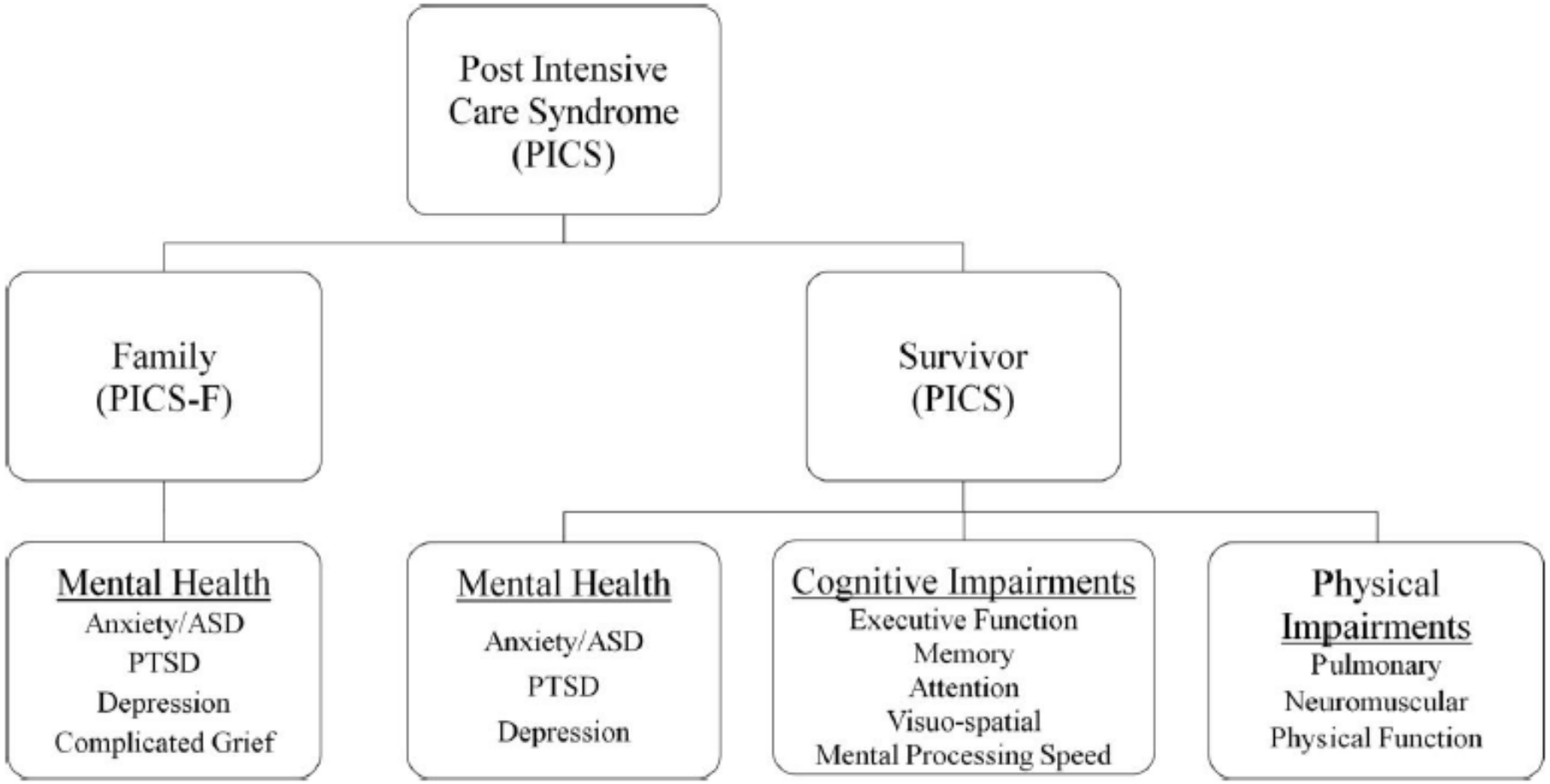
- Ongoing shortness of breath, weakness, fatigue
- Trouble with memory and concentration
- Recurring nightmares and sleep problems
- Unable to work
- Struggling financially
- Still living with parents







Post-intensive care syndrome



Needham D. *CCM* 2012

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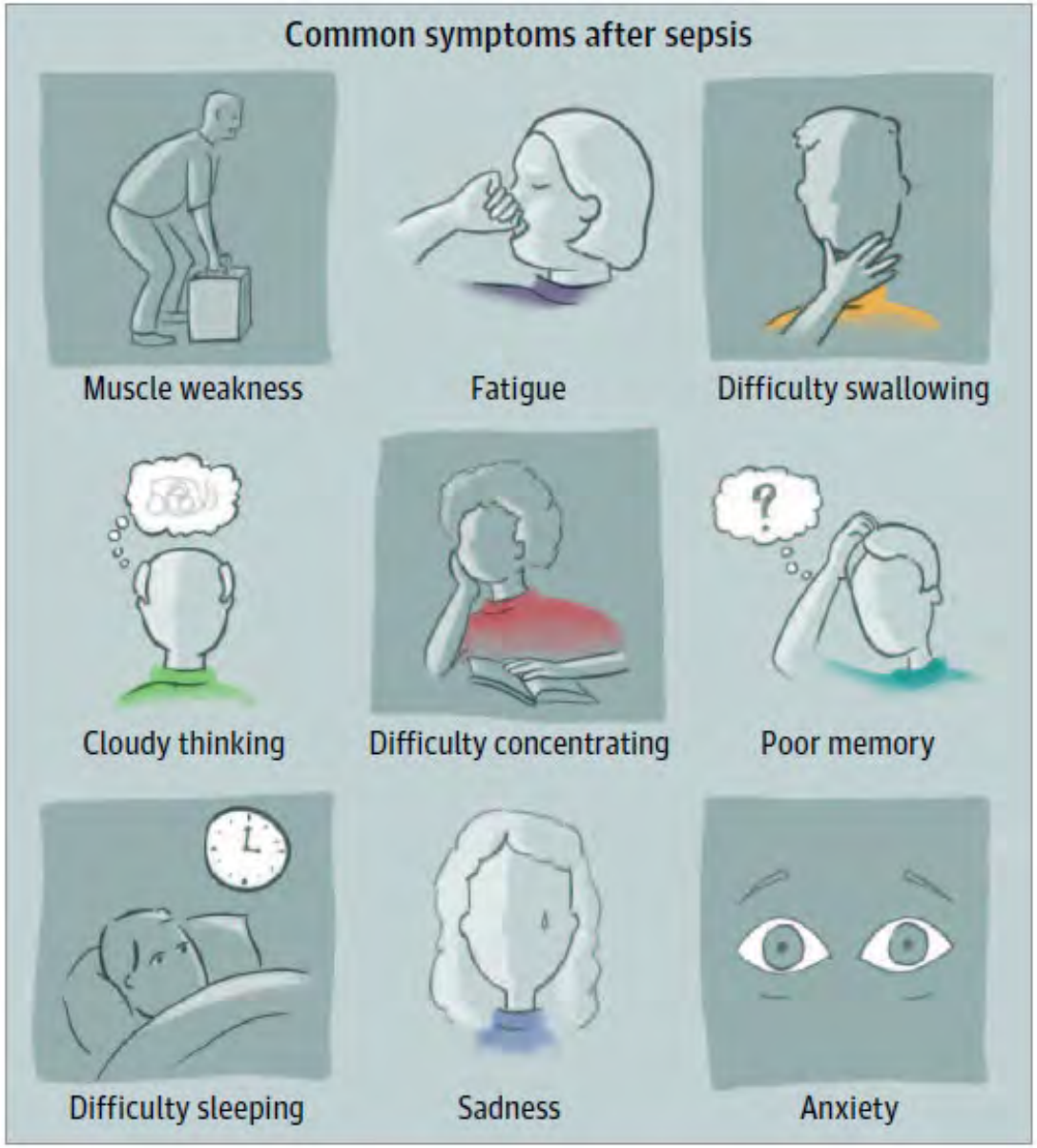
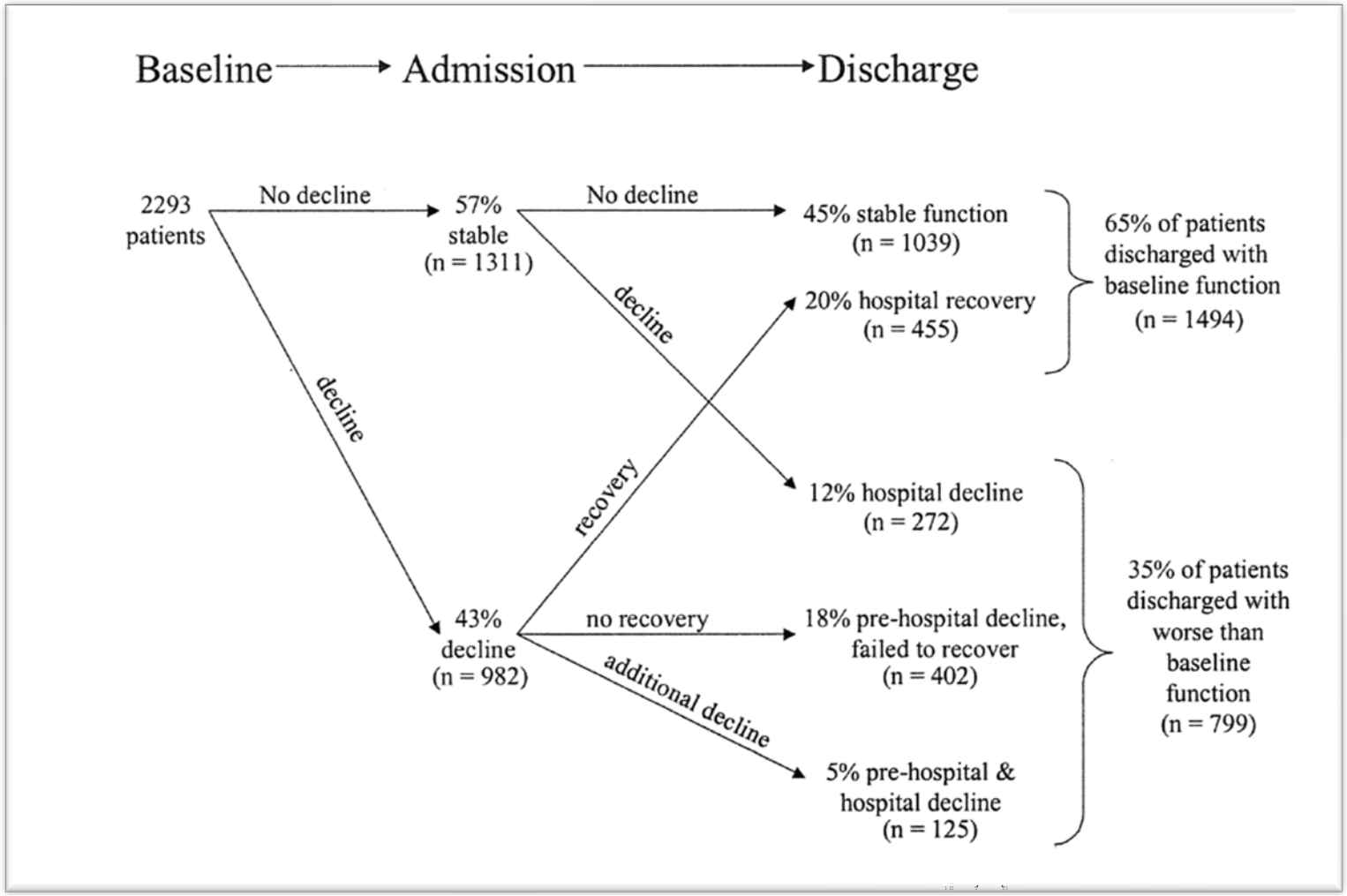
(Is PICS *really* just about the ICU?)

Post-sepsis morbidity looks just like PICS… even without an ICU stay



Prescott H. *JAMA* 2018

Over 1/3 of older acute care survivors have functional decline



Covinsky KE. *JAGS* 2003

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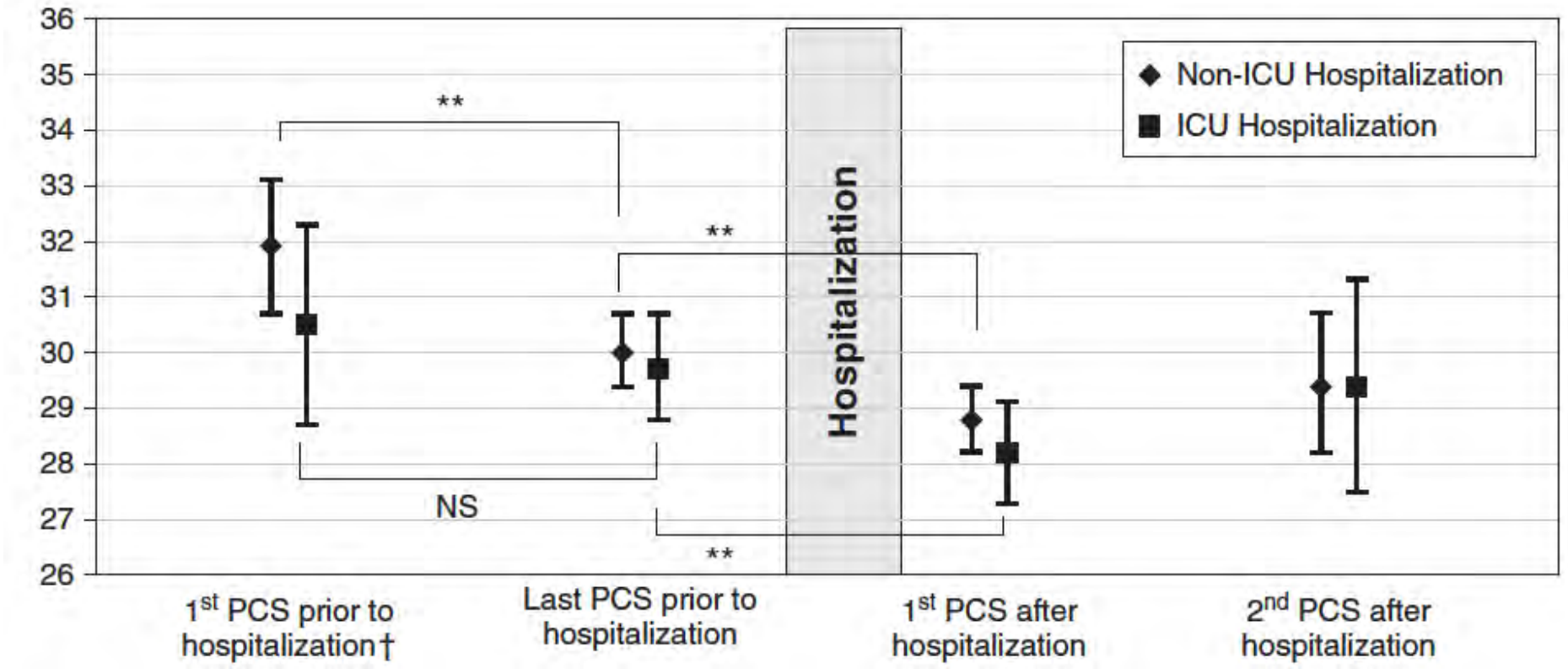
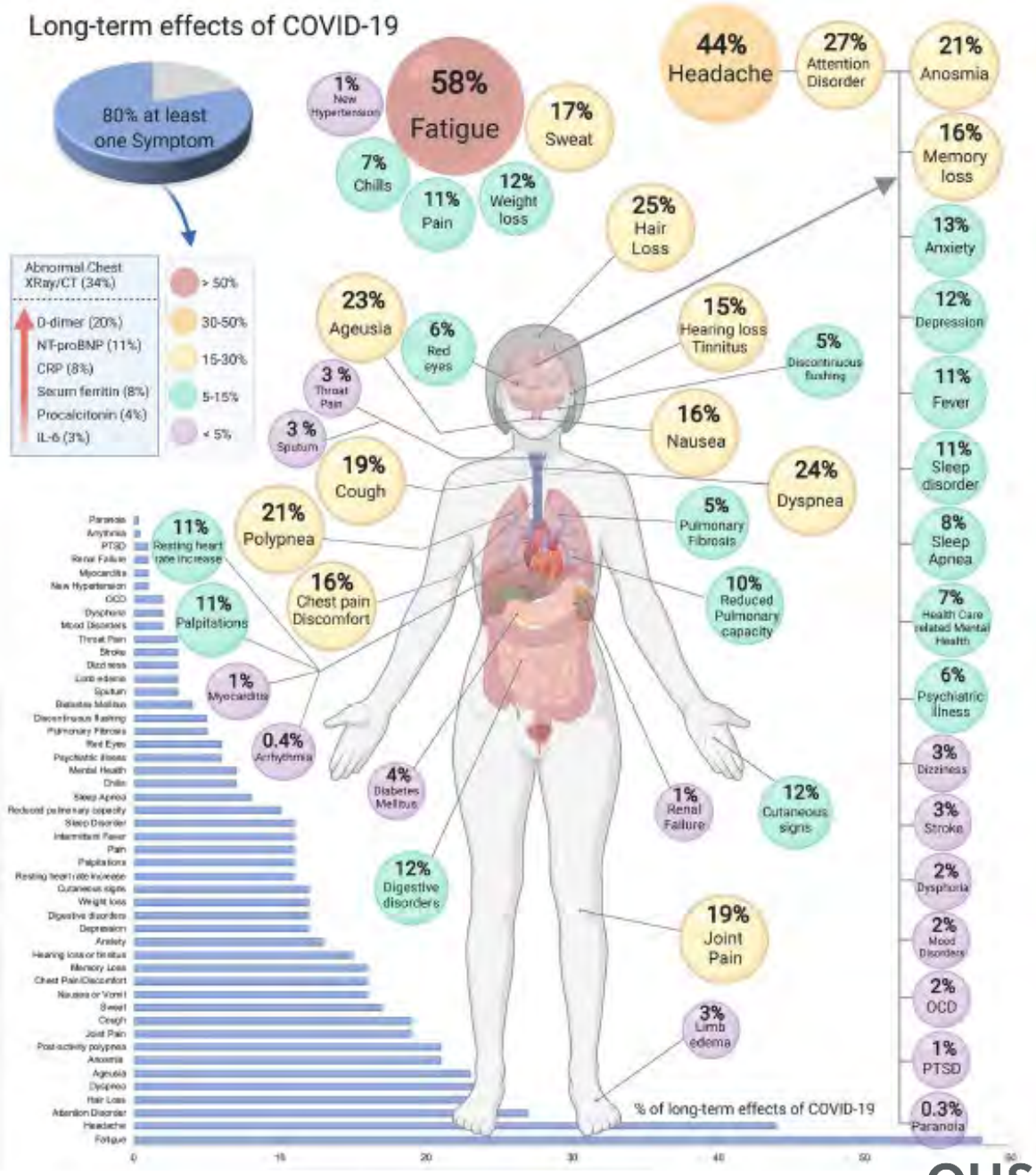
Decline in physical health-related quality of life after both acute care and ICU hospitalization



PCS= Physical component score from SF-36

Feemster LC. *Annals ATS* 2015


Long-term effects of COVID-19
80% at least one Symptom
Abnormal Chest XRay/CT (34%)
D-dimer (20%)
NT-proBNP (11%)
CRP (8%)
Serum ferritin (8%)
Procalcitonin (4%)
IL-6 (3%)
> 50%
30-50%
15-30%
5-15%
< 5%
1% New Hypertension
58% Fatigue
17% Sweat
7% Chills
11% Pain
12% Weight loss
44% Headache
27% Attention Disorder
21% Anosmia
16% Memory loss
13% Anxiety
12% Depression
11% Fever
11% Sleep disorder
8% Sleep Apnea
7% Health Care related Mental Health
6% Psychiatric Illness
3% Dizziness
3% Stroke
2% Dysphoria
2% Mood Disorders
2% OCD
1% PTSD
0.3% Paranoia
25% Hair Loss
23% Ageusia
6% Red eyes
3 % Throat Pain
3 % Sputum
19% Cough
15% Hearing loss Tinnitus
5% Discontinuous flushing
16% Nausea
24% Dyspnea
5% Pulmonary Fibrosis
10% Reduced Pulmonary capacity
21% Polypnea
11% Resting heart rate increase
16% Chest pain Discomfort
11% Palpitations
1% Myocarditis
0.4% Arrhythmia
4% Diabetes Mellitus
1% Renal Failure
12% Cutaneous signs
12% Digestive disorders
19% Joint Pain
3% Limb edema
% of long-term effects of COVID-19

Questions to address

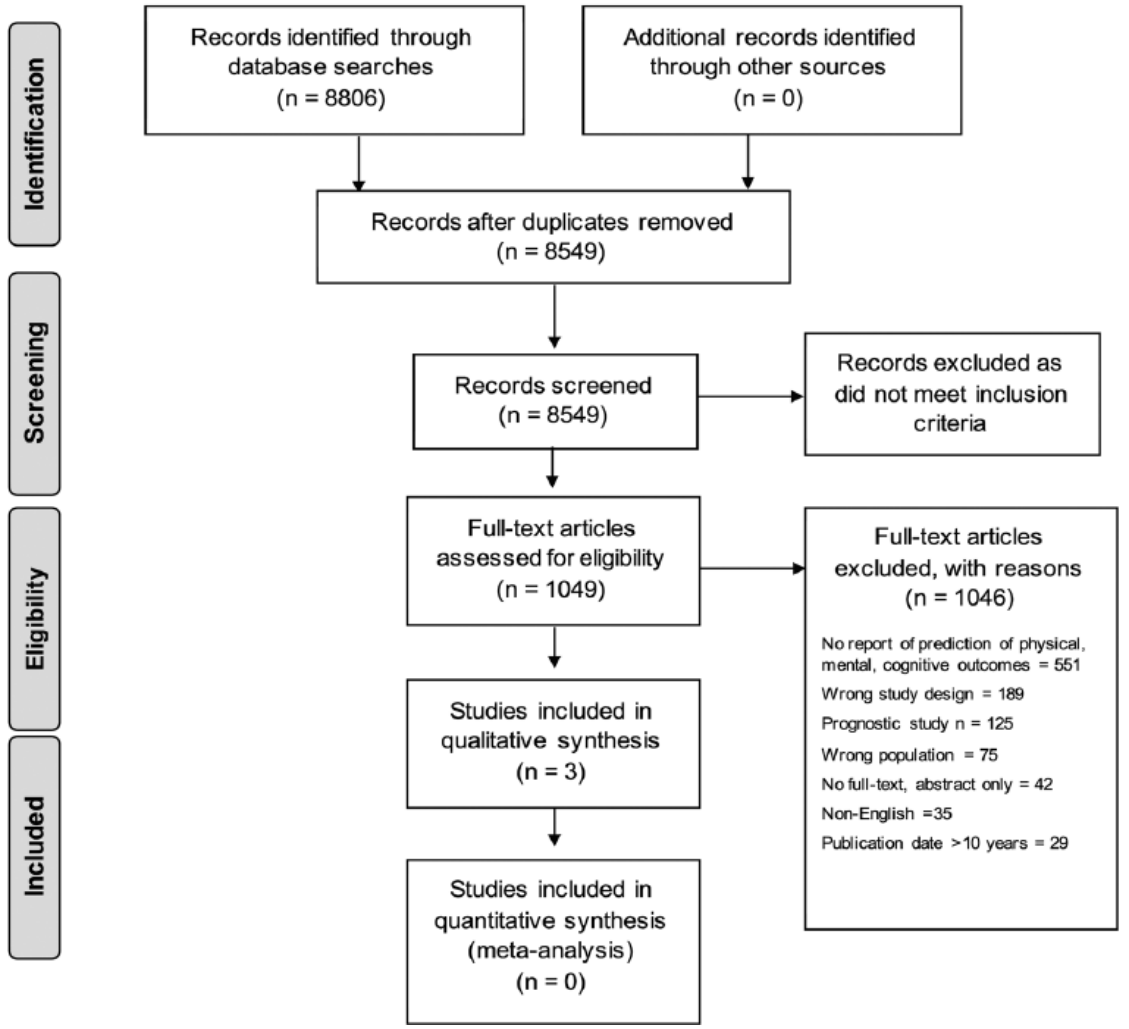
- What are the long-term sequelae after critical illness?
- Which patients are at high risk for post-ICU impairment?
- How can we improve outcomes?

No good prediction models for PICS

Prediction Models for Physical, Cognitive, and Mental Health Impairments After Critical Illness: A Systematic Review and Critical Appraisal

Kimberley J. Haines, PhD, BHSc (Physiotherapy)[1,2]; Elizabeth Hibbert, B.Physiotherapy[1]; Joanne McPeake, PhD, MSc, BN (Hons), RGN[3–5]; Brian J. Anderson, MD, MSCE[6]; Oscar Joseph Bienvenu, MD, PhD[7]; Adair Andrews, RN, MATD[8]; Nathan E. Brummel, MD MSCI, FCCM[9]; Lauren E. Ferrante, MD, MHS[10]; Ramona O. Hopkins, PhD[11–13]; Catherine L. Hough, MD, MSc[14]; James Jackson, PsyD[15]; Mark E. Mikkelsen, MD, MSCE[16]; Nina Leggett, DPT, BBiomed[1]; Ashley Montgomery-Yates, MD[7]; Dale M. Needham, MD, PhD[17]; Carla M. Sevin, MD[18]; Becky Skidmore, MLS[19]; Mary Still, APRN, ACNS, ANP-BS, CCRN[20]; Maarten van Smeden, PhD[21]; Gary S. Collins, PhD[22]; Michael O. Harhay, PhD[23]

Conclusions: We only found three studies that developed a prediction model of any post-ICU impairment. There are several opportunities for improvement for future prediction model development, including the use of standardized outcomes and time horizons, and improved study design and statistical methodology.



Haines KJ. *Crit Care Med* 2020

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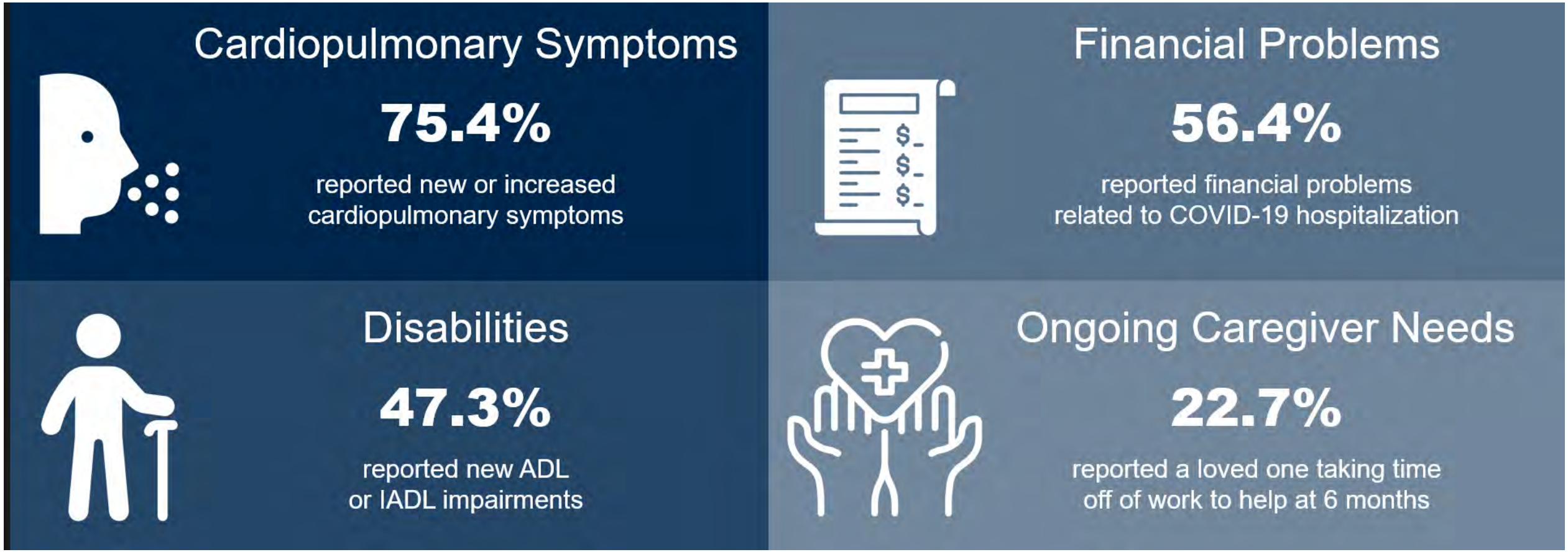
Most have impairments after COVID hospitalization



Admon AJ, Iwashyna TJ, Kamphuis LA, Gundel SJ, Sahetya SK, Peltan ID, Chang SY, Han JH, Vranas KC, Mayer KP, Hope AA, Jolley SE, Caldwell E, Monahan ML, Hauschildt K, Brown SM, Aggarwal NR, Thompson BT, Hough CL, PETAL Network. *JAMA Network Open*, 2023

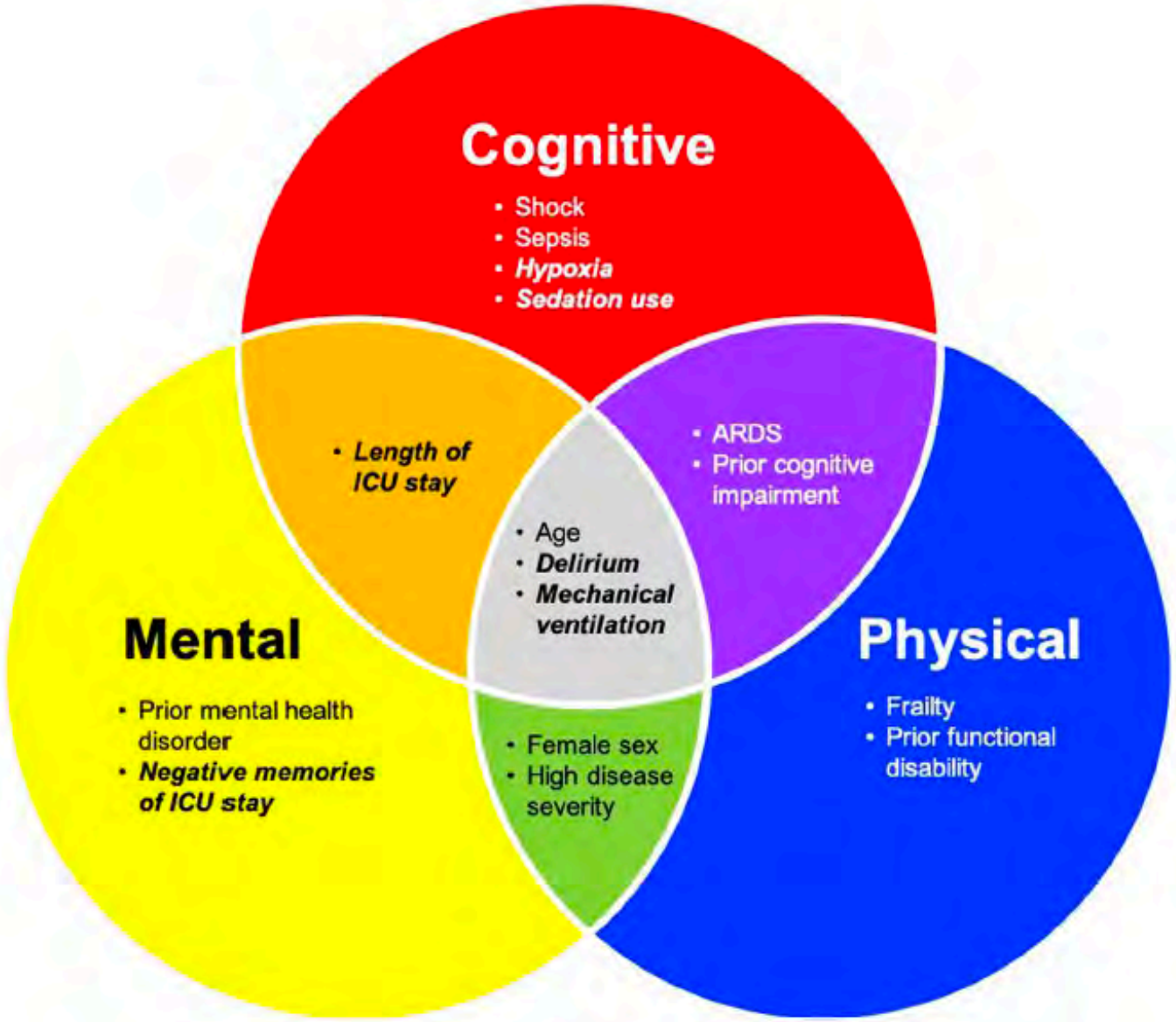

Cognitive
• Shock
• Sepsis
• Hypoxia
• Sedation use
• Length of ICU stay
• ARDS
• Prior cognitive impairment
• Age
• Delirium
• Mechanical ventilation
Mental
• Prior mental health disorder
• Negative memories of ICU stay
• Female sex
• High disease severity
Physical
• Frailty
• Prior functional disability

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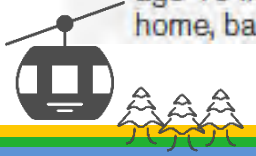
TABLE 2. Association of Predictors With Patients' Experience of Financial Stress[a]

Predictors	Single-Predictor Models[b]				Multi Predictor Model[c]			
	Valid *n*[d]	β	95% CI	*p*[e]	Valid *n*[d]	β	95% CI	*p*[e]
Female	442/175	0.519	0.191–0.848	**0.002**	405/161	0.478	0.110–0.846	**0.011**
Racial/ethnic minority	436/173	0.306	−0.044 to 0.656	0.086		0.168	−0.233 to 0.568	0.412
Age, yr, baseline	442/175	−0.015	−0.028 to −0.001	**0.029**		0.006	−0.014 to 0.026	0.546
Marital status, baseline	442/175			0.059				0.459
Currently married		0.000				0.000		
Previously married		0.260	−0.122 to 0.641			0.269	−0.154 to 0.693	
Never married		0.488	0.079–0.897			0.118	−0.350 to 0.586	
Insurance, baseline[f]	442/175			0.091				0.065
Medicare		0.000				0.000		
Medicaid		0.480	−0.031 to 0.991			0.404	−0.192 to 0.999	
Commercial		0.179	−0.207 to 0.565			0.443	−0.057 to 0.943	
None		0.664	0.041–1.288			0.848	0.182–1.515	
Cancer as chronic comorbidity	442/175	−0.563	−1.027 to −0.098	**0.018**		−0.478	−1.122 to 0.165	0.145
Financially comfortable, baseline[g]	441/174	−0.309	−0.458 to −0.161	**< 0.001**		−0.235	−0.408 to −0.061	**0.008**
Any children under age 10 living at home, baseline	442/175	0.606	0.100–1.113	**0.019**		0.707	0.106–1.309	**0.021**



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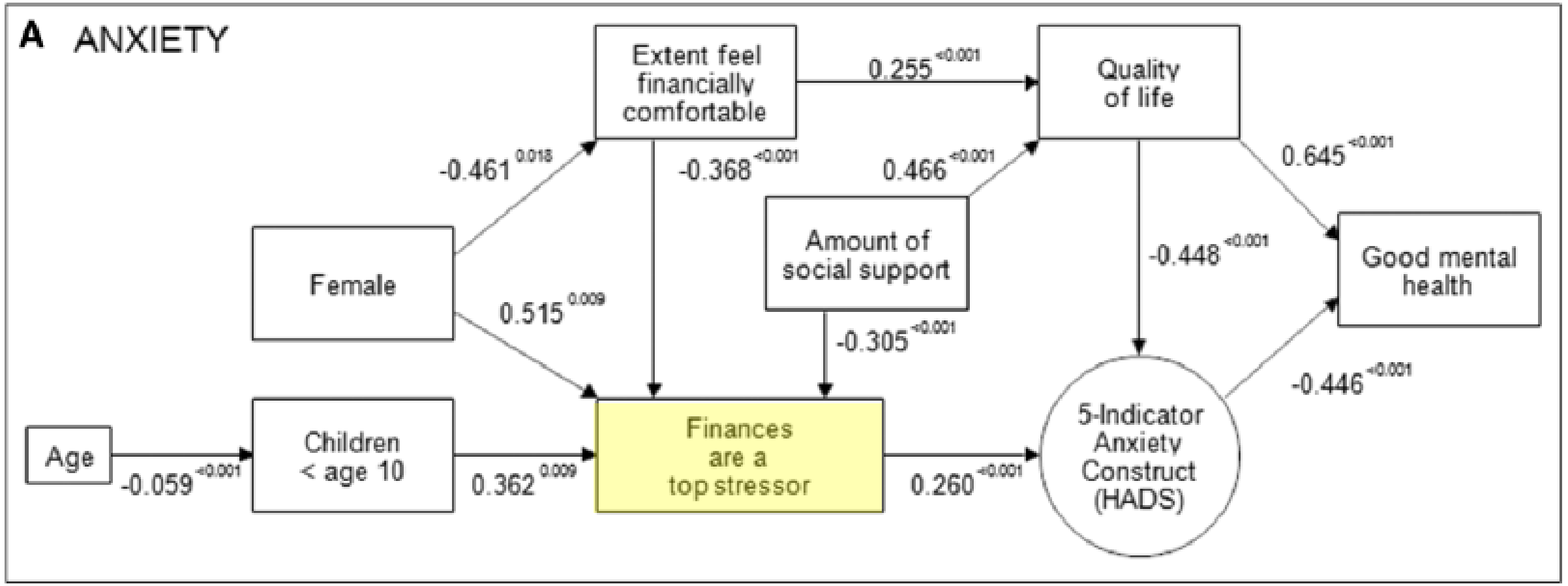
Anxiety may be mediated by financial stress



Khandelwal N. *Crit Care Med* 2018

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Most patients report financial impact after COVID hospitalization

Variable	Month 1	Month 3	Month 6	*P* value[b]
No.	677	624	639	
At any time because of COVID-19 hospitalization, have you…				
Used up all or most of savings?	215 (31.80)	203 (33.12)	221 (34.80)	.14
Been unable to pay for necessities?	133 (19.67)	137 (22.10)	129 (20.35)	.69
Been contacted by a collection agency?	65 (9.62)	85 (13.80)	103 (16.30)	<.001
Skipped or delayed medical care because of cost?	52 (7.70)	64 (10.32)	59 (9.29)	.20
Taken less medications because of the cost?	42 (6.22)	48 (7.75)	42 (6.62)	.72
Declared bankruptcy?	7 (1.04)	8 (1.29)	9 (1.42)	.52
Since our last contact, have you…				
Had a loved one take time off work?	264 (39.23)	173 (27.86)	145 (22.69)	<.001
Had to change work?	96 (14.26)	94 (15.19)	75 (11.74)	.13
Been told that insurance would not cover therapy or rehab?	32 (4.77)	36 (5.87)	45 (7.08)	.05
Lost a job?	56 (8.30)	49 (7.85)	41 (6.41)	.14
Been told that insurance would not cover equipment?	45 (6.71)	32 (5.20)	32 (5.06)	.14
Prevalence of any financial problem	449 (66.13)	369 (59.04)	361 (56.41)	<.001

Admon A. *JAMA Network Open* 2023

Socioeconomic disadvantage associated with new disability

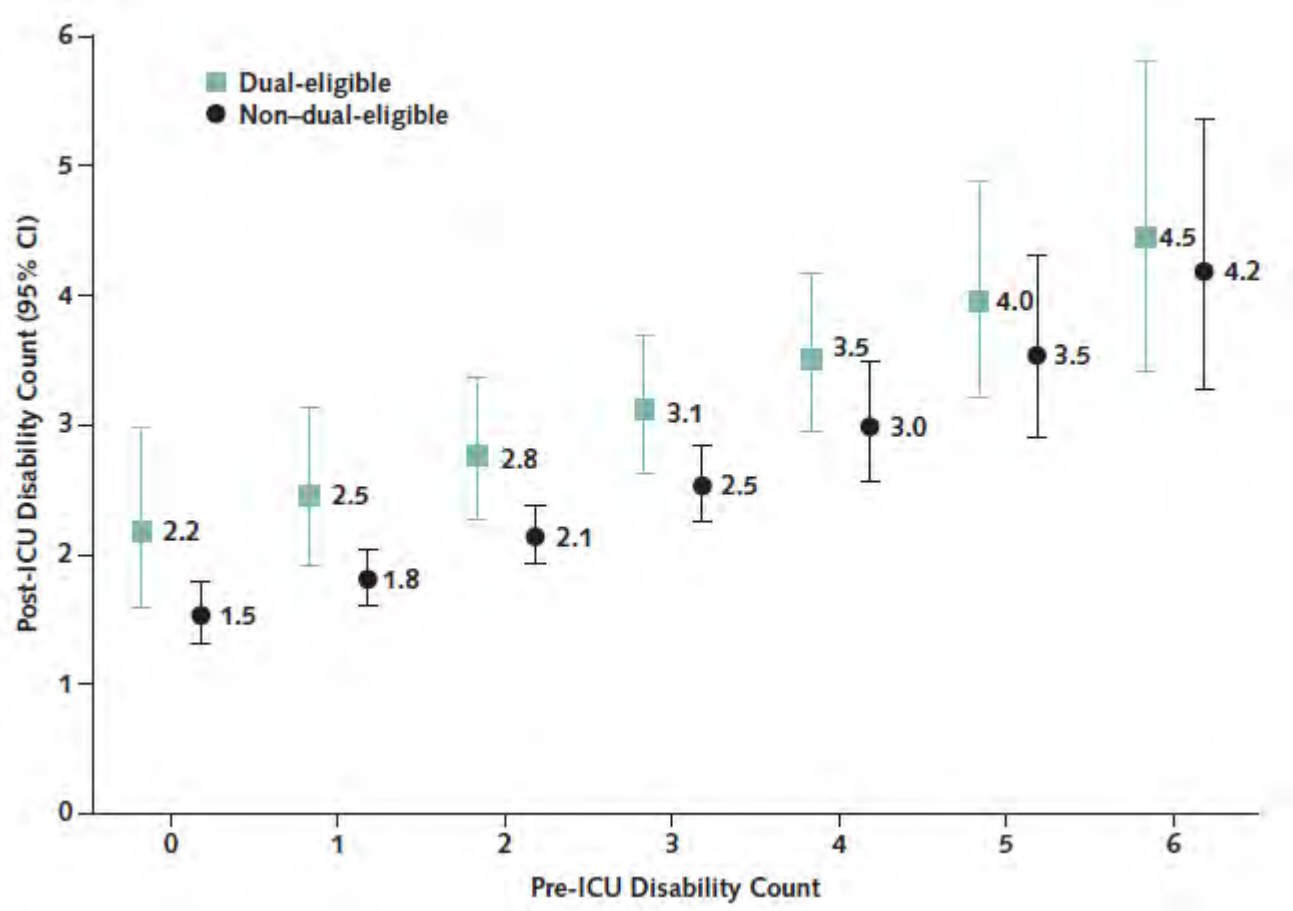
Community-dwelling adults

National Health and Aging Trends Study

Hospitalizations 2011–2017

Disadvantage = Medicare/Medicaid dual eligibility

Physical function measures
(*n* = 641 admissions, 537 persons)



Jain S. *Annals Int Med* 2022

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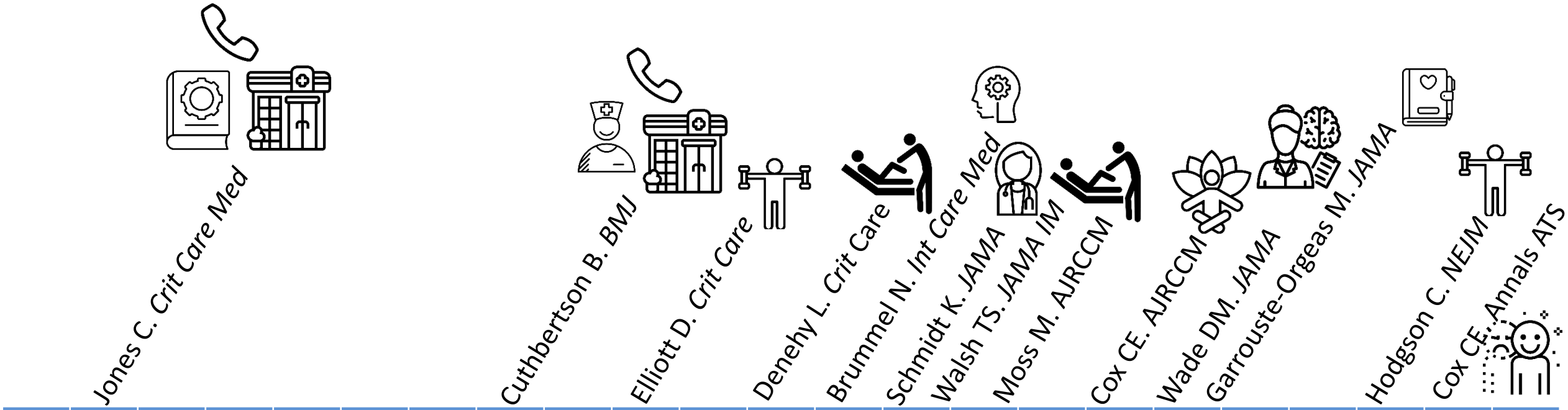
Questions to address

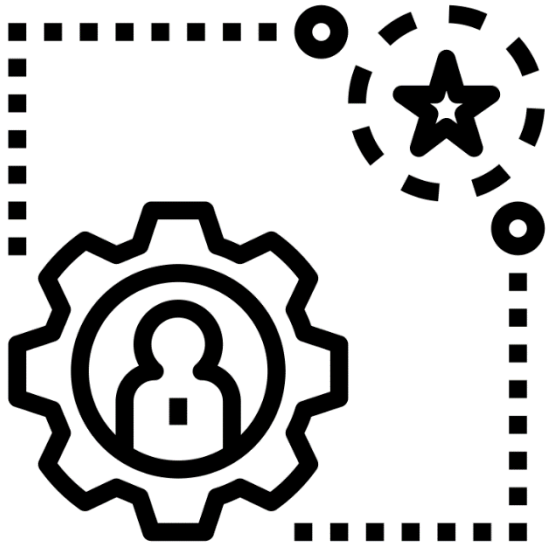
- What are the long term sequelae after critical illness?
- Which patients are at highest risk for post-ICU impairment?
- How can we improve outcomes?

Over two decades of trials to improve post-ICU outcomes…

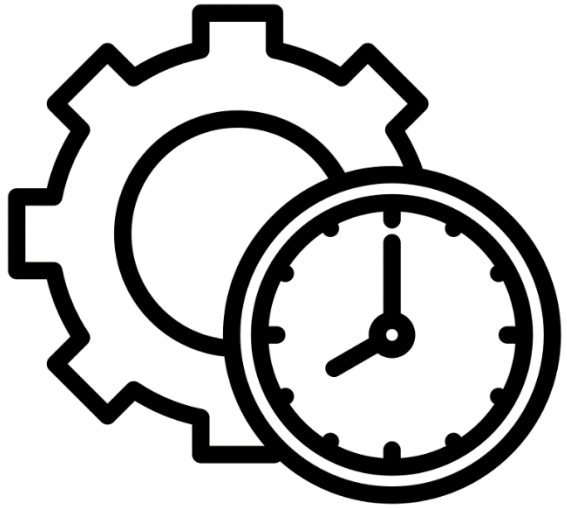


…without clear evidence of benefit.

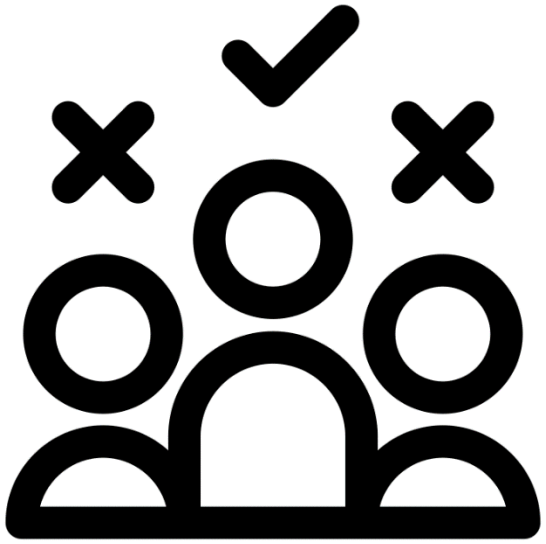
Key knowledge gaps



Outcome

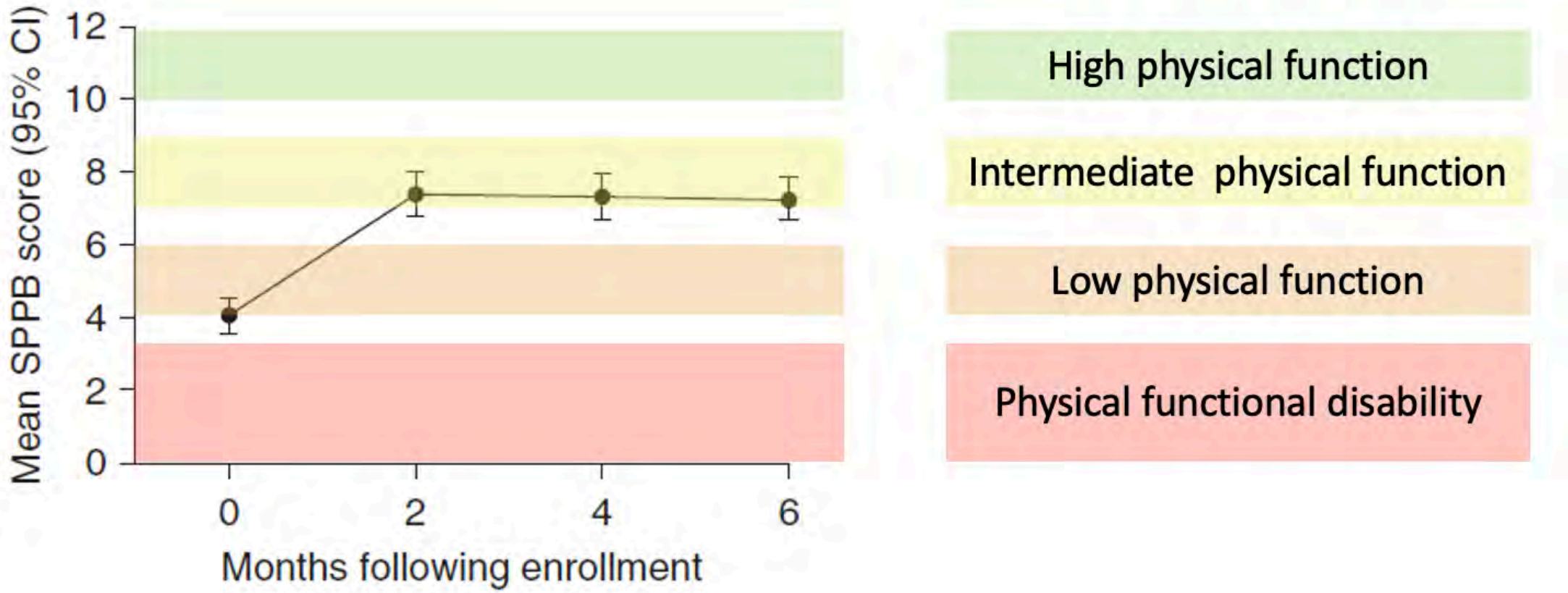


Timing



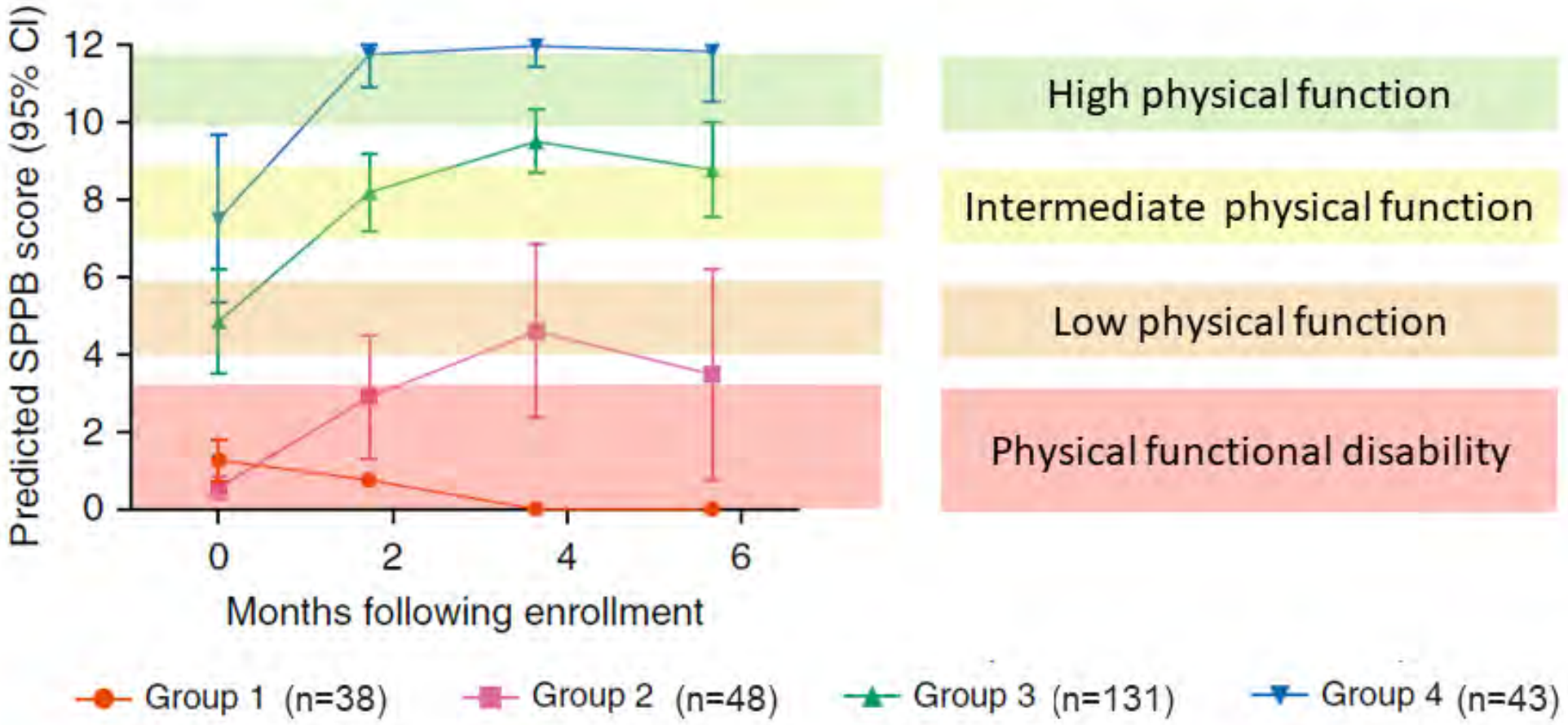
Patient

Understanding recovery phenotypes may improve trials



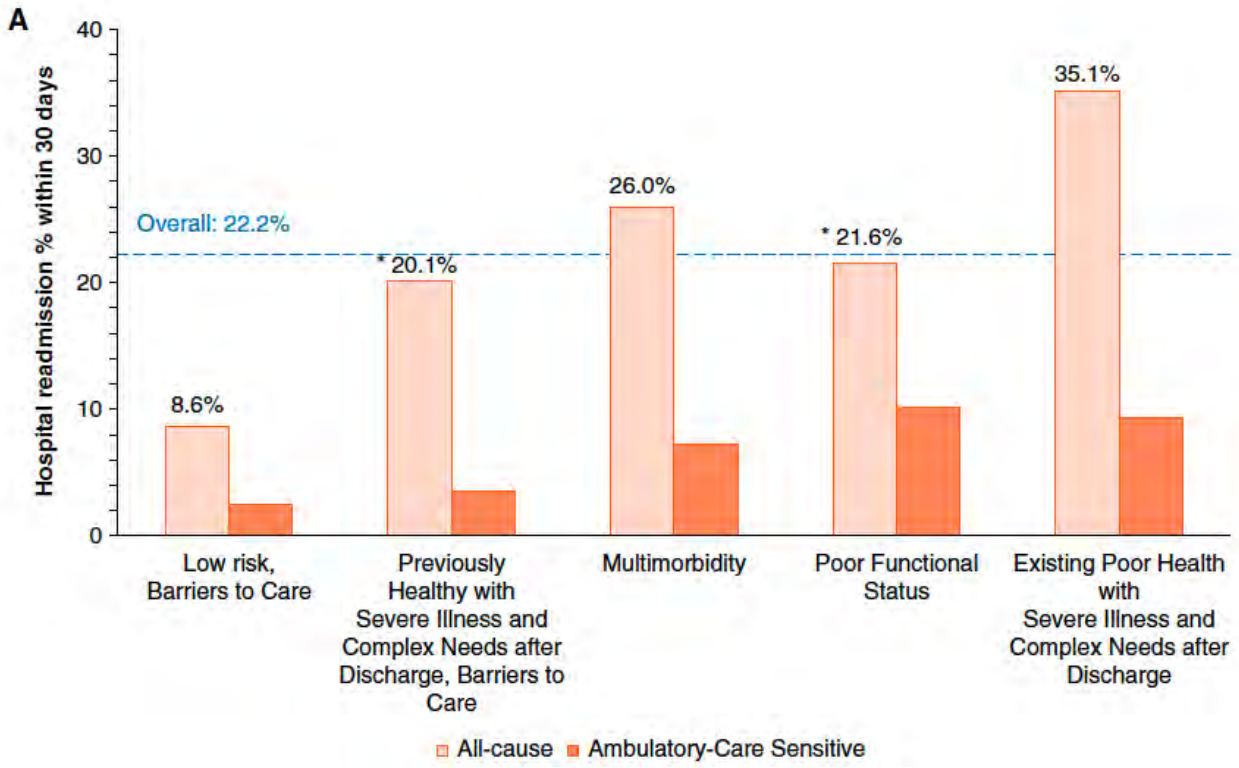
Gandotra S. *Annals ATS* 2018

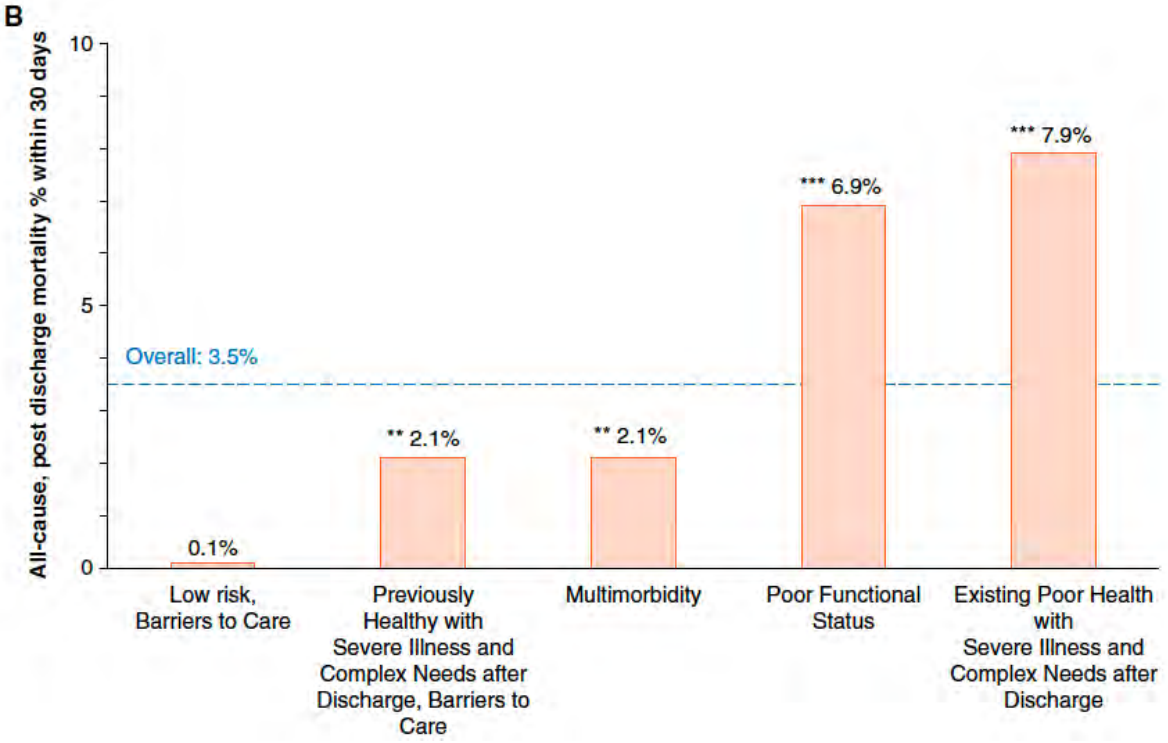
Four different trajectories of physical functional recovery



Gandotra S. *Annals ATS* 2018

Clusters of clinical characteristics associated with risk after sepsis hospitalization

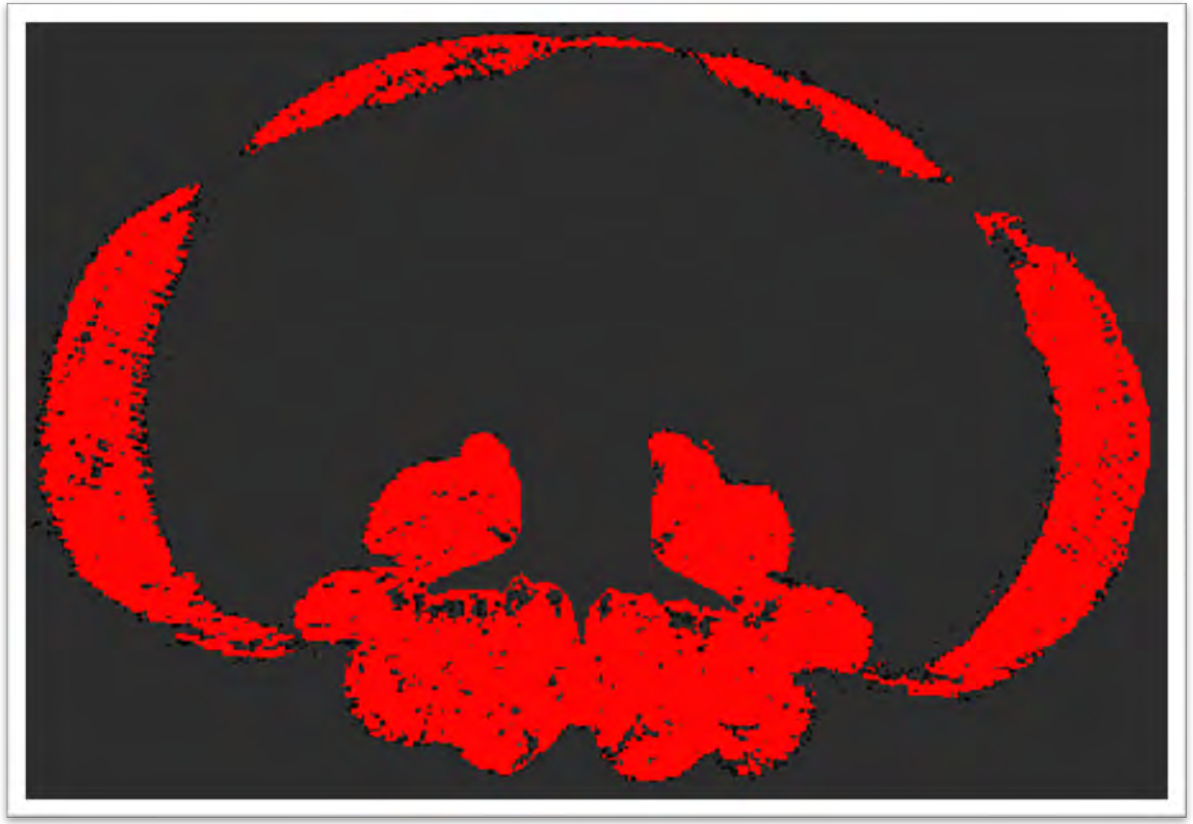


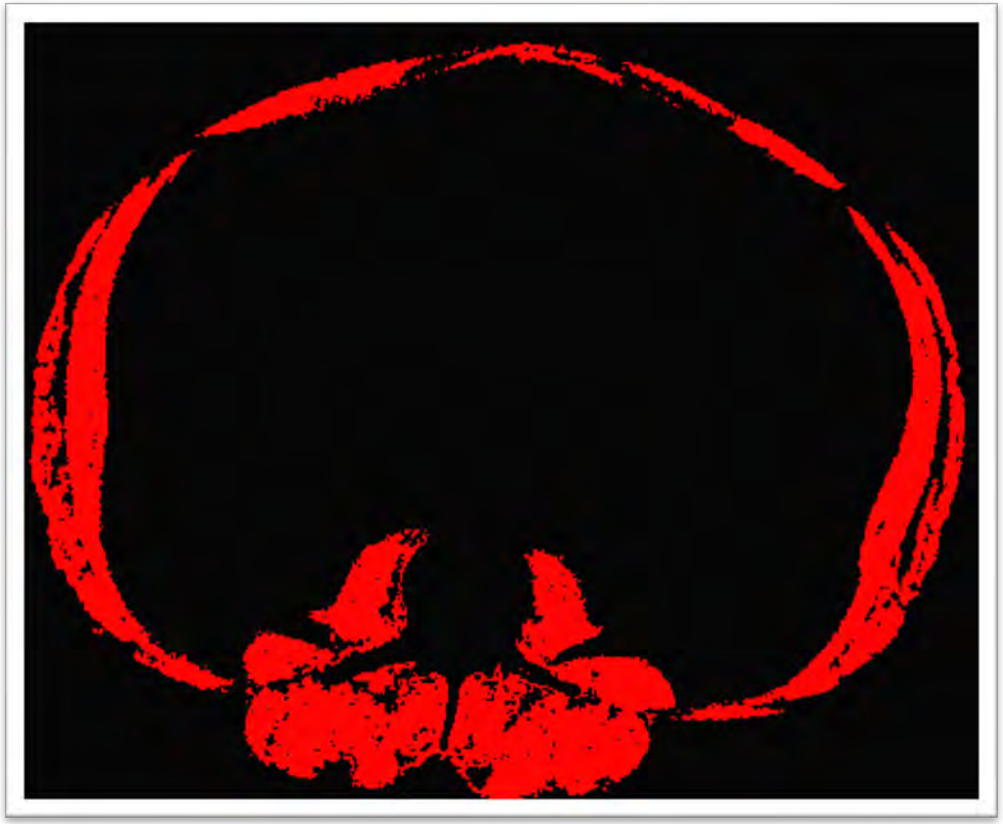


Taylor SP. *Annals ATS* 2022

OHSU

Potential for radiomic phenotyping of frailty?

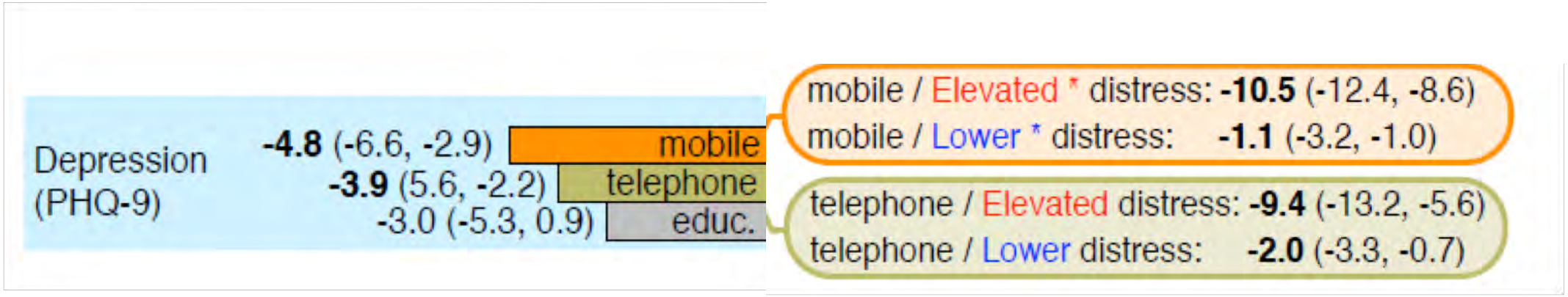




Davis C. *ATS abstract* 2016

Effects of mindfulness training programmes delivered by a self-directed mobile app and by telephone compared with an education programme for survivors of critical illness: a pilot randomised clinical trial

Christopher E Cox,[1,2] Catherine L Hough,[3] Derek M Jones,[1,2] Anna Ungar,[3] Wen Reagan,[1,2] Mary D Key,[1,2] Tina Gremore,[4] Maren K Olsen,[5,6] Linda Sanders,[7] Jeffrey M Greeson,[8,9] Laura S Porter

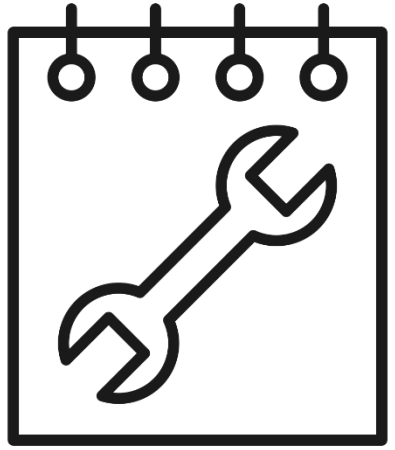


*Elevated distress = baseline PHQ-9 >=10
*Lower distress = baseline PHQ-9 <10

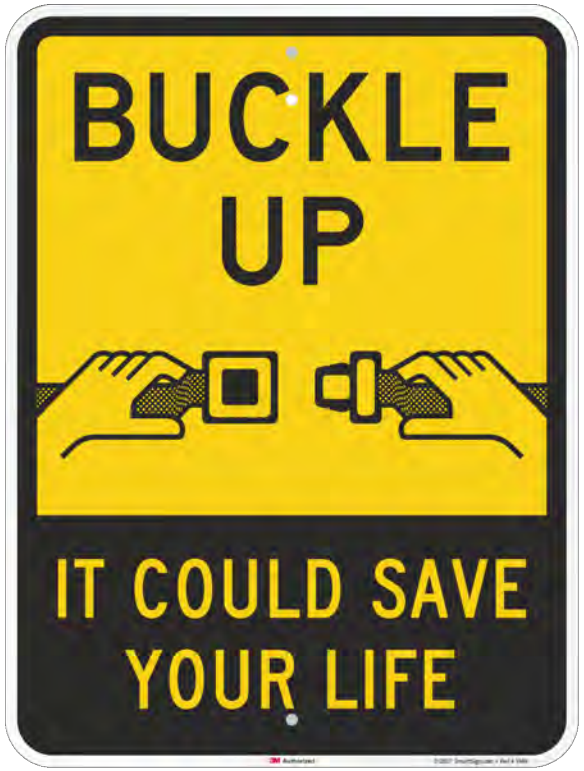
Cox CE. *Thorax* 2017

OHSU

Opportunities to improve outcomes while we build the boat



Prevent critical illness and injury



At ICU admission

- Learn about patient's pre-ICU function and trajectory
- Identify goals, expectations, and home environment

During ICU stay

- Maximize organ function and chances of survival with high quality critical care
- Minimize potential harms from ICU treatments
- Incorporate opportunities to shorten the duration of critical illness

Post-ICU: Best Practices from Surviving Sepsis '21

- Screen for social and economic support; provide referrals
- Use shared decision making in discharge planning
- Reconcile medications at ICU & hospital discharge
- Provide information regarding hospital stay and common post-ICU impairments in written and oral instructions
- Follow-up with clinicians who can manage support new sequelae
- Assess and follow-up physical, cognitive, and emotional problems after hospital discharge

Evans L. *Crit Care Med* 2021

Current adoption of best practices is incomplete

Care Practice	All ($N = 365$), n (%)
Medication optimization	
No medication errors	342 (93.7)
Status evaluation at discharge	
Functional	302 (82.7)
Speech/swallow	116 (31.8)
Mental	127 (34.8)
Sepsis education	
Advised to monitor	73 (20.0)
Follow-up scheduling	
No appointment scheduled at time of discharge	106 (29.0)
Scheduled within 2 wk	199 (54.5)
Scheduled within > 2 and < 4 wk	60 (16.4)
Goal-Aligned	
GoC or palliative care indicated[a], but did not occur	160 (43.8)
GoC and/or palliative care indicated[a] and did occur	84 (23.1)

Watson MA. *Crit Care Med* 2022

So much more to learn!

- Partnership with patients and families
- Quality Improvement
- Research and implementation

primrose

SunRISE

coral

PrOFOCCI

lift

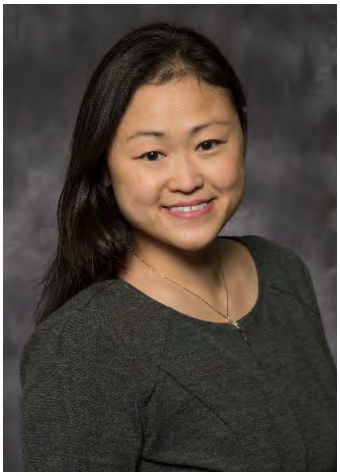
blueprint

EXPERT

Conclusions


Thank you!
houghc@ohsu.edu
@Terri_Hough

Tracheal Issues in the ICU



Jennifer Y Lee, MD
Clinical Associate Professor
Stanford University

Dr. Lee is a clinical associate professor in the Department of Otolaryngology–Head and Neck Surgery at Stanford University School of Medicine. She went to medical school at the Albert Einstein College of Medicine in the Bronx, NY. She underwent her otolaryngology residency training at the University of Pennsylvania and came to Stanford in 2013.

She is a comprehensive otolaryngologist who manages and operates on pathologies from a perforated ear drum to thyroid carcinoma to sinusitis to salivary tumors. She has received regional and national recognition for her work in management of dysfunctions of the Eustachian tube. Through the Clinical Effectiveness Leadership Training (CELT) program at Stanford, she has collaborated with multiple disciplines for an elective tracheotomy pathway for degenerative neuromuscular patients leading to reduction in ICU stay by 30%. She has mentored residents in quality improvement projects reducing tracheotomy wound breakdowns in the ICU to 0%.

Dr. Lee serves as the medical director of the Stanford Health Care adult otolaryngology service line. She collaborates with administrators and physicians and nurses to provide high quality healthcare access to patients across the network. This role has helped foster her dedication to quality improvement and to communication between team members to help improve outcomes for the patients in their care.

Dr. Lee's research has focused on outcomes of patient care relating to dilatory and patulous dysfunction of the Eustachian tube. She also has received regional and national recognition for her innovations in the management of dysfunctions of the Eustachian tube.

She helps to educate the specialists of the future in her field by leading the Stanford otolaryngology residency training program in simulation education. Her goals are to improve patient outcomes as well as establish the foundation for how doctors lead teams through otolaryngology emergencies.

Stanford MEDICINE
School of Medicine

Tracheostomy Issues in the MICU

Jennifer Y Lee, MD
Clinical Associate Professor
Clinic Chief of Adult Otolaryngology Service Line
Department of Otolaryngology Head and Neck Surgery

Disclosures

Consultant for Acclarent – Eustachian Tube Balloons – not relevant to presentation today.

Case 1

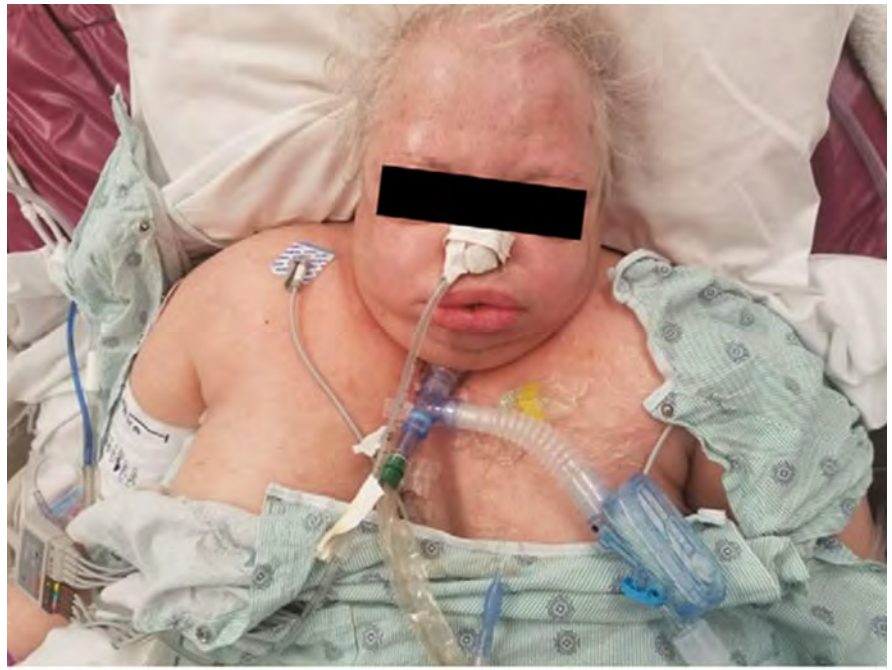
Mr Pine is a 65 year old POD #2 tracheotomy for prolonged intubation.

He has decreased tidal volume on the ventilator.

His oxygen saturation is 92% on 28% FIO2.

What would you do next?

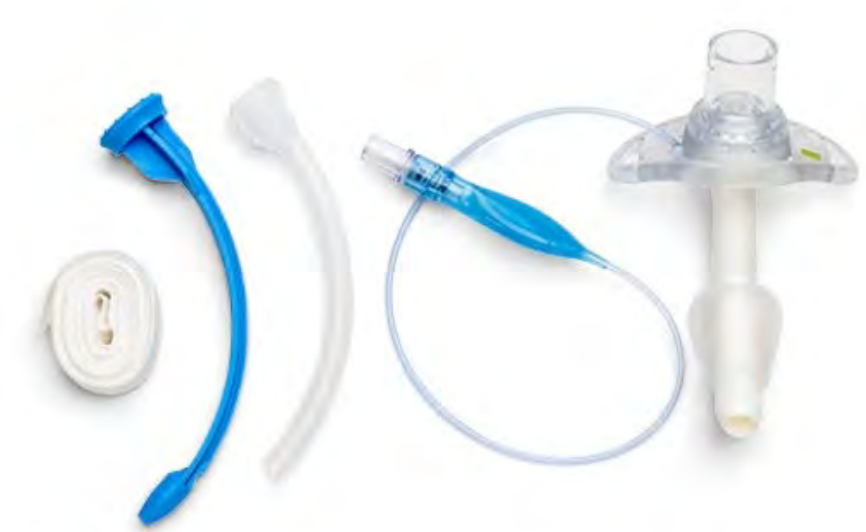
Troubleshooting



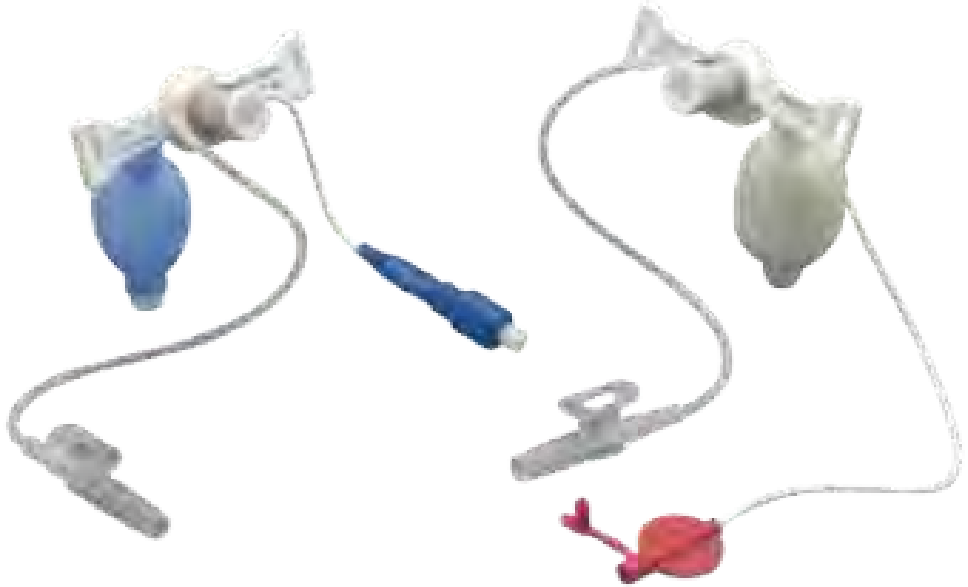
1. Is the circuit disconnected?
2. Can you pass suction?
3. What systemic causes can contribute?

Circuit Connection

Circuit Connection

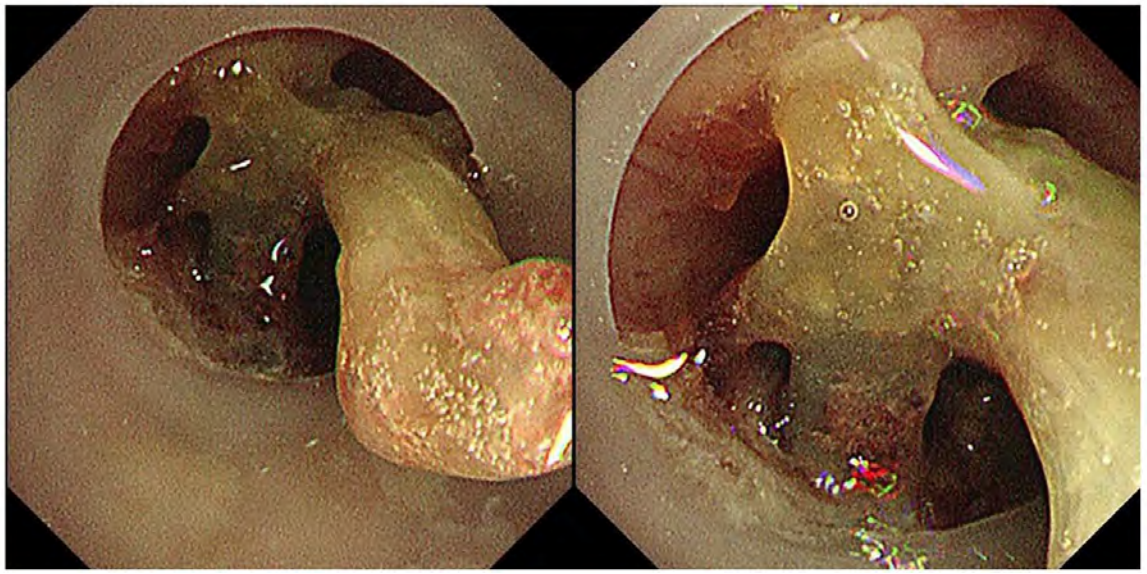


Flexible Shiley



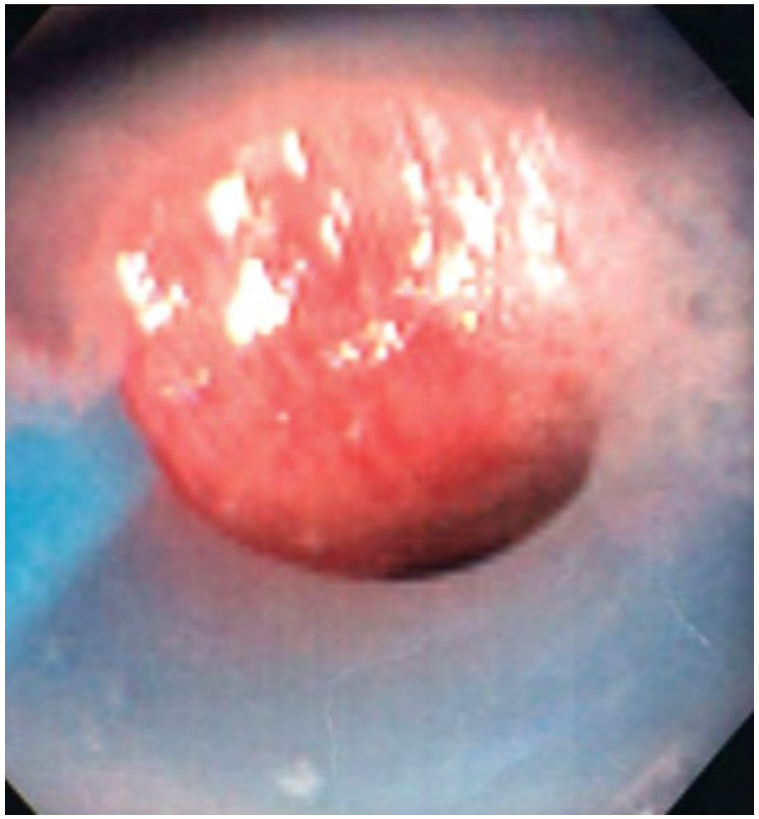
Bivona

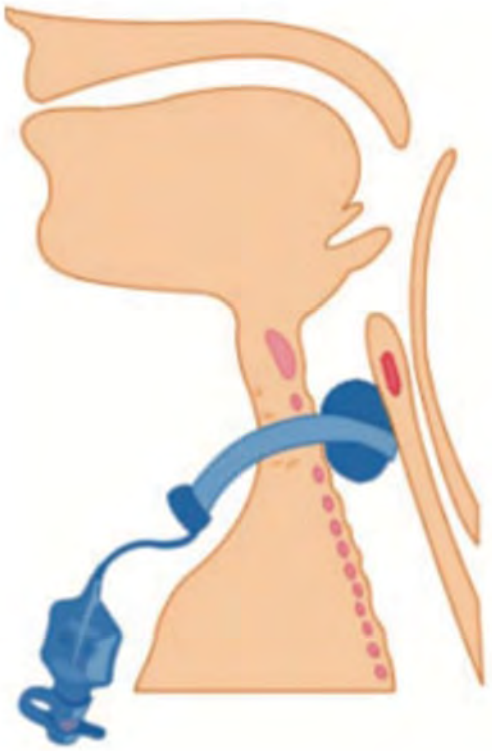
Mucous plugging



1. Change out inner cannula
2. Saline with suction
3. Bronchoscopy
4. Exchange tube

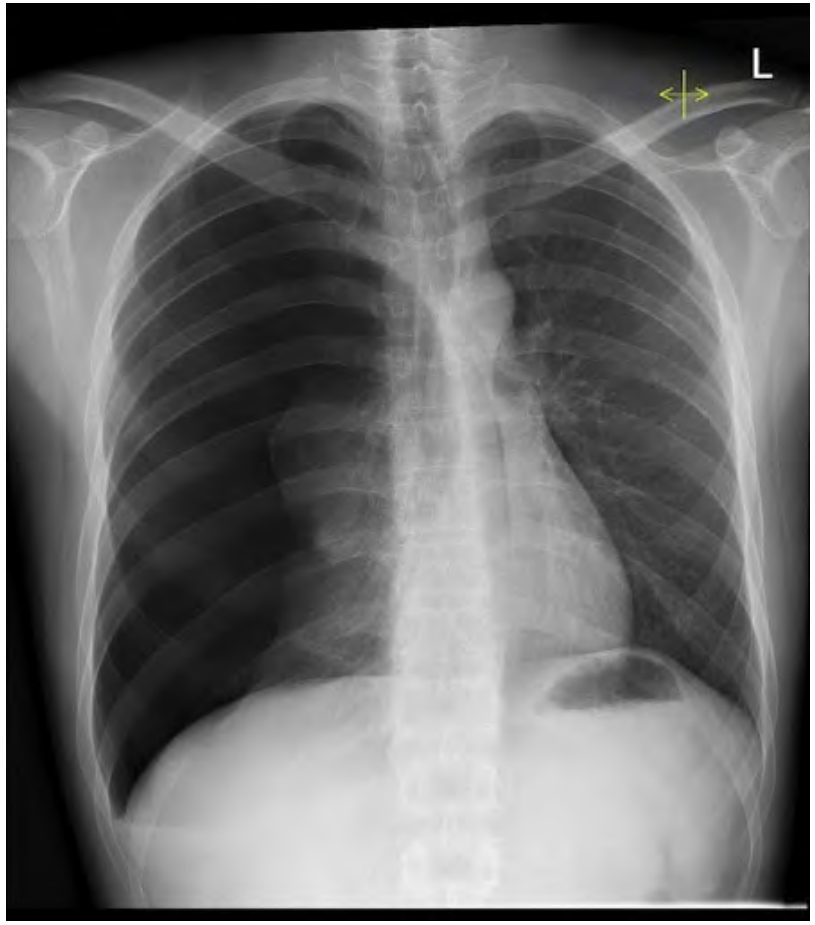
Backwalling

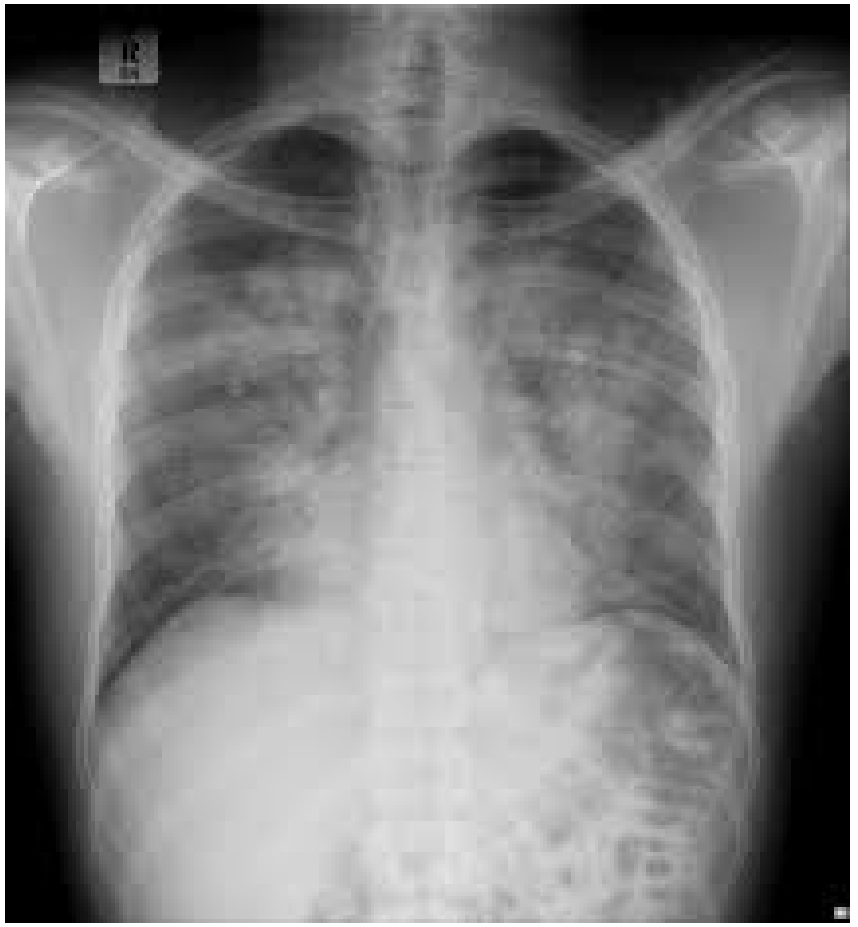




1. Make sure trach plate is flush with neck
2. Rotate and elevate the trach off of the chest
3. Insert a longer trach tube

Systemic Causes



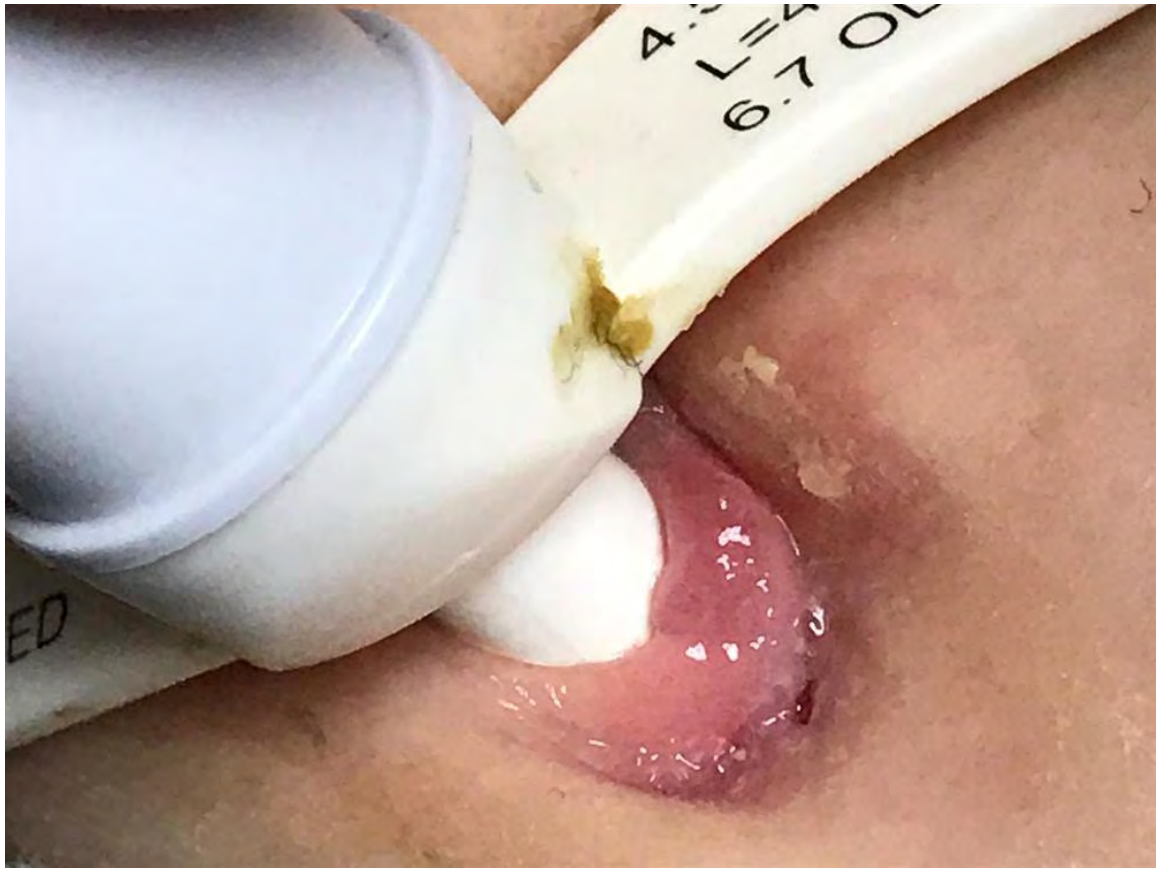


Case 2

Mrs Everest is a 75 year old transfer from another hospital after complications of a kidney transplant with a tracheotomy placed 2 months ago who the bedside nurse reports is having bleeding.

What would you do next?

Bleeding

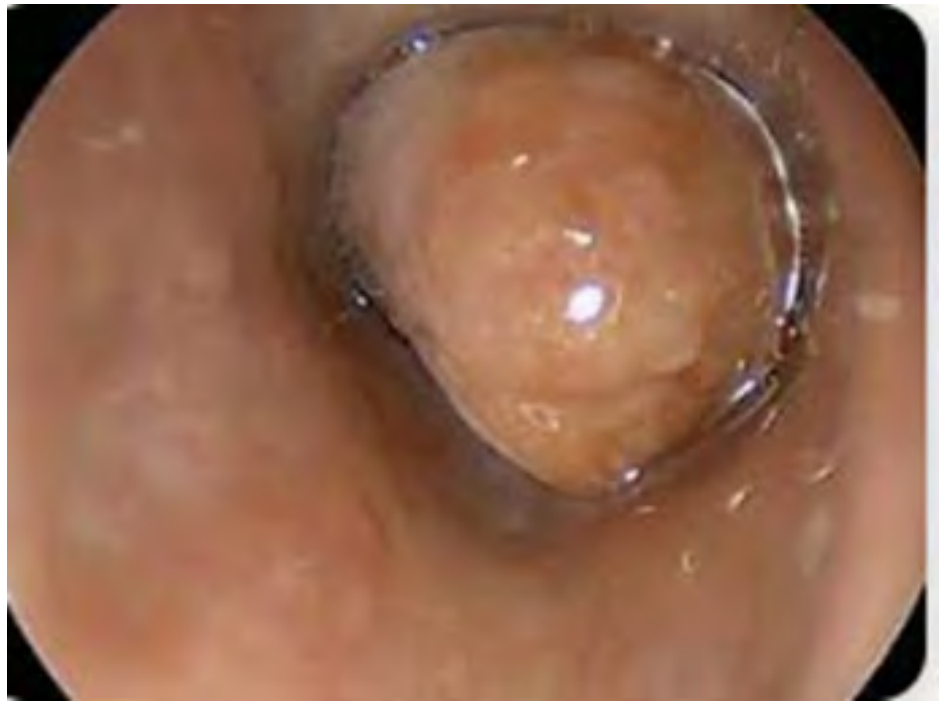


Granulation

Pressure

Silver nitrate

Bleeding



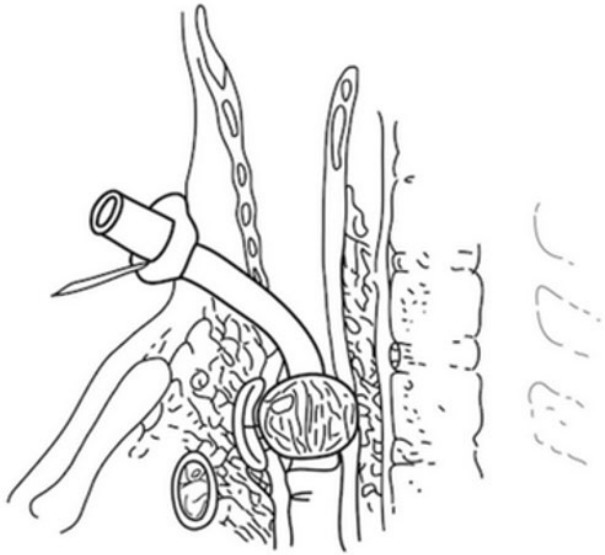
Tracheal granulation

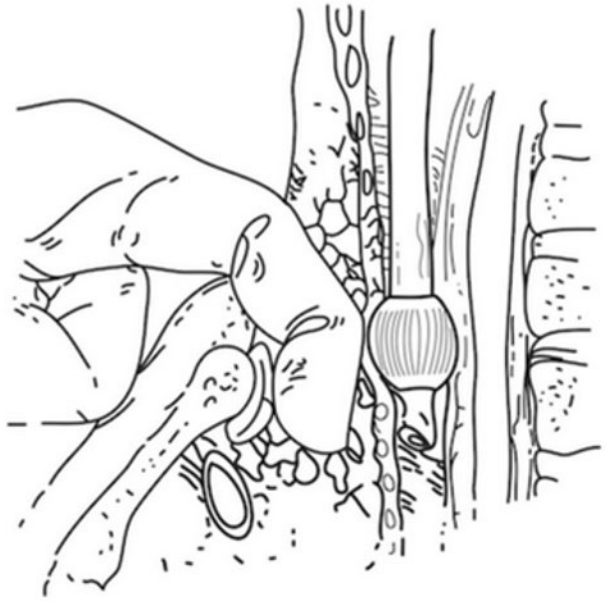
Steroids

Remove

Bypass

Bleeding





Tracheoinnominate Artery Fistula

- **Hyperinflate balloon**
- **Finger Occlusion**
- **Transfusion**

Conclusion

Thank you!

Michelle Cao
CELT 2021
SMLA Cohort 5
REVIVE
CISL
Jennifer Alyono
Anna Messner
Rob Jackler
Tina Stankovic

Role of Speech Therapy in the ICU

Sara Nolette, MA CSD CCC-SLP
Speech Language Pathologist
VA Palo Alto

Ms. Sara Nolette received her Master's Degree in Communication Sciences and Disorders with Specialization in Speech-Language Pathology from Montclair State University. Following completion of her clinical fellowship year in a skilled nursing facility, she worked in the intensive care units and inpatient rehabilitation units at Rhode Island Hospital, Brockton Hospital, and Lawrence & Memorial and Westerly Hospitals (Yale New Haven Health). Currently, she is an acute speech pathologist working for the VA's Palo Alto division specializing in dysphagia and dysphonia management in the critical care and tracheostomy populations. She is the Speech Pathology representative for the upcoming tracheostomy team.

Role of the Speech Language Pathologist (SLP) in the ICU

Sara Nolette, M.A. CSD CCC-SLP

Disclosures

- Relevant Financial disclosures:

  Receives honorarium for this presentation.

  Relevant Nonfinancial disclosures:

- *Full-time employee of the US Department of Veterans' Affairs, Palo Alto Division.*

  Utilizes Passy-Muir Valves in daily practice.

  Member of the ASHA Special Interest Groups for Swallowing and Swallowing Disorders (SIG 13).

Agenda

- Historical Practice
- Terms to Know
- Reactive Approach in the ICU
- (Surprising?) Cases Needing SLP
- Proactive Approach in the ICU
- SLPs in the ICU: Best Practice
- Benefits of SLP Involvement

What is a speech pathologist?

SLPs provide diagnosis and treatment of swallowing, speech, language, or cognitive disorders in critically ill patients secondary to acute neurological or medical conditions and patients following complex neurological, cardiac, and general surgery

(McRae, Montgomery, Garstang, and Clearly, 2020)

Historical Use Of SLPs in ICU

- ICU providers seem to have limited awareness of dysphagia in ICU patients, knowledge of dysphagia-related sequelae, and knowledge of best practices for dysphagia evaluation and treatment (Spronk et al, 2022)
- Few ICUs have a dedicated SLP (Cardinal, Freeman-Sanderson, & Togher, 2020; Mpouzika et al, 2023; Rodrigues et al, 2015; Siao et al, 2023; Spronk et al, 2022; Wiberg, Whitling, & Bergstrom, 2022)
- Approach has been largely reactive
- Referrals to SLP arere often only made due to patient or team concern, or when "difficulties" arise (Black et al, 2021; Cardinal, Freeman-Sanderson, & Togher, 2020)

Historical Use (or Lack Thereof) of SLPs in ICU

- Less than 20% of ICUs in Australia have automatic referrals (Cardinal, Freeman-Sanderson, & Togher, 2020)
- Less than 25% of patients receive SLP consults when SLP was available (Mpouzika et al, 2023)
- Less than 30% of patients who staff *expected* to have dysphagia received consults for SLP services (Spronk et al, 2022)
- Despite availability of gold standard SLP assessments, they are sometimes only used *after* a patient has received dysphagia treatment, and only when "doubt" and dysphagia "persist" (van Snippenburg et al, 2019)
  - In 49% of ICUs, no active dysphagia rehabilitation was practiced
- When SLPs are consulted, important variables to dysphagia (such as laryngeal pathology and swallow initiation) are overlooked (Scheel et al, 2016)

Dysphagia in the ICU

- Dysphagia is highly prevalent (12% of extubated ICU patients; 18% of all emergency admissions; 82% of elderly patients), but likely **underdiagnosed** in ICUs (Giraldo-Cadavid, Bastidas, et al, 2022; Spronk et al, 2022; Zuercher et al, 2022)
- Pathophysiology is **multifactorial** and includes (Clayton et al, 2024; Macht et al, 2013; Masuda et al, 2022; McIntyre et al, 2022; Zuercher et al, 2019):
  - ICU-acquired weakness
  - Reduced sensorium
  - Dyssynchronous breathing
  - GERD
  - Oropharyngeal/laryngeal trauma
  - Age
  - Physical function
  - Frailty
  - Polymedication
  - Multiple comorbidities

Dysphagia in the ICU: A Critical Issue

- *Dysphagia* is a risk factor:
  - Morbidity and mortality in critically ill patients (Masuda et al, 2022; Schefold et al, 2017; Zielske et al, 2014).
  - Prolonged hospital and ICU LOS (McIntyre et al, 2022)
  - Feeding tube placement and pneumonia (Clayton et al, 2024)
  - Aspiration pneumonia
    - Patients with dysphagia have an 11x greater risk of developing aspiration pneumonia (Kim Park, & Song, 2015)
- *Aspiration associated with dysphagia* is a risk factor:
  - Aspiration detected on FEES is associated with a threefold increase of risk of pneumonia and fourfold increase of risk of death (Giraldo-Cadavid, Bastidas, et al, 2022)
- *Undetected and/or untreated dysphagia* can lead to malnutrition, prolonged ICU/hospital LOS, and increased healthcare costs (Zuercher et al, 2022)
- *Persistent dysphagia* is associated with increased risk of pneumonia, reintubation, and death (Zielske et al, 2014)
- Increased risk of mortality persists for **up to one year** after admission (Zuercher et al, 2022)

Communication in the ICU: Patient Centered?

- **1/3 of patients have difficulty communicating** due to their medical status (Cardinal, Freeman-Sanderson, & Togher, 2020)
  - Patients who cannot communicate are **3x more likely to have a preventable adverse event**
  - Patients who cannot communicate are a higher fall risk
- Inability to communicate leads to anxiety, frustration, anger, and untreated pain in ICU patients (Newman et al, 2022)
- Despite the clear dangers posed to patients who cannot communicate, the majority of SLP referrals to ICU are for dysphagia management (74.1%) (Cardinal, Freeman-Sanderson, & Togher, 2020)
- If SLPs are consulted at all for communication and/or PMV use, it is often later than recommended (Davis et al, 2021; Wiberg, Whitling, & Bergstrom, 2022)

To check in..

1. How many of you consult SLPs for your patients in the ICU on a daily basis?
2. How many of you have one or more SLPs dedicated to your ICU alone?
3. Do you know the difference between aspiration and penetration?
4. Do you know the difference between a screen, clinical swallow evaluation (CSE), videofluoroscopic swallow study (VFSS), and flexible endoscopic evaluation of swallowing (FEES)?

TERMS TO KNOW

	Definition	Expected response	Silent	Airway Invasion?
Aspiration	When a substance goes beneath the vocal folds	Cough/throat clear	No overt s/s	Yes
Penetration	When a substance goes above OR makes contact with the vocal folds	Swallow	N/A	Yes

Per Borders et al, 2019; Macht, White, & Moss (2014); Richard & Smith (2019); Steele & Miller (2010)

TERMS TO KNOW: WHICH TEST IS WHICH?

- There are 17 physiological components to one swallow (Martin-Harris et al, 2008). Many of these components involve ***internal musculature*** *and* ***cannot be visualized at bedside.***
- **Nursing Swallow Screen:** non-standardized; many variations. Pass/fail (Brodsky et al, 2014; Schefold et al, 2017).
- **Clinical swallow evaluation:** consists of a chart review, patient interview and patient reported outcome measures, an oral motor and cranial nerve exam, and (sometimes) a 3 oz water swallow challenge and PO presentations (Brodsky, Nollet, Spronk, et al, 2020; Brodsky et al, 2014).
- **Videofluoroscopic swallow study (VFSS):** consists of a fluoroscopy procedure where the patient travels to Radiology and eats/drinks barium of different consistencies. This is usually completed in the lateral and anterior-posterior projections (Brodsky et al, 2014; Martin-Harris et al, 2008; McRae, 2018; Zuercher et al, 2019).
- **Flexible endoscopic evaluation of swallowing (FEES):** consists of a nasolaryngoscopy in which the swallowing components are examined from the superior view while the patient eats/drinks food/liquids dyed different colors (Brodsky et al, 2014; Krisciunas et al, 2020; McRae, 2018; Miller, Schroeder, & Langmore, 2020)

VFSS and FEES are gold standard for swallowing assessment (Zuercher et al, 2019; Hongo et al, 2022)

A Reactive Approach

- Some ICUs will use a screen over SLP evaluation
  - Nearly 50% of ICUs use a screen, despite its low sensitivity to detecting aspiration (Brodsky et al, 2017; Spronk et al, 2022)
- Clinical swallow evaluations seem to be utilized as first line in some ICUs because they are "convenient," with 60% of respondents reporting using CSEs (Black et al, 2021; Lee et al, 2016; Scheel et al, 2016)
- The reflex use of the CSE is inappropriate:
  - CSE underestimates aspiration risk in patients, and **silent aspiration cannot be detected by CSE** (Black et al, 2021; Kim, Park, & Song, 2015; Leder & Espinosa, 2002; Leder & Warner, 2018)
    - 14% of patients with acute respiratory failure who appeared to be able to eat/drink safely during a CSE were found to aspirate on a FEES (Lynch et al, 2017)
  - Clinicians who used only CSE to evaluate swallow function had an 83% inability to determine laryngeal/pharyngeal anatomy, 90% inability to determine bolus flow characteristics, and **88% inability to determine overall swallow safety** (Leder, 2015)

Use of Non-EBP:

- *Evaluating dysphagia* in the acutely ill is often unstandardized (Scheel et al, 2016), despite FEES and VFSS being the gold standard assessments in the critically ill (Zuercher et al, 2019)
  - Pulse oximetry: systematic review found there was no relationship on pulse oximetry during PO intake and identified simultaneous aspiration on an instrumental exam (Britton et al, 2018)
  - Cervical auscultation: 6-12% of patients with dysphagia would be missed when relying on cervical auscultation (Lagarde, Kamlaski, & van den Engel-Hoek, 2016)
  - Gag reflex: 93% of patients with a normal gag reflex were found to be aspirating on a VFSS; 95% of patients without a gag reflex were not aspirating on a VFSS (Leder, 1997)
- *Thickening liquids without SLP imaging:*
  - Thickened liquids do not prevent aspiration in all people with dysphagia (Kaneoka et al, 2017; Vilardell et al, 2016)
  - Thicker liquids are more likely to be silently aspirated, and can cause pulmonary injury (Nativ-Zeltzer et al, 2018); or pneumonia (Rogus-Pulia & Robbins, 2013)
  - Thickened liquids can lead to dehydration, which in turn may lead to electrolyte imbalance, fecal impaction, cognitive impairment, UTI, constipation, functional decline, and death (Langmore et al, 2002, Panther, 2016)
- *Chin tuck:*
  - The chin tuck is only effective in 55% of individuals with dysphagia (Terre & Mearin, 2012)
- *NG tube placement to prevent aspiration:*
  - NG tube does not reduce risk of aspiration; in fact with gastric contents, risk of reflux is increased in comparison to those without NG tube (Kim et al, 2018; Rogus-Pulia & Robbins, 2013)

Post-Extubation Dysphagia (PED)

- Intubation itself can impact swallowing function, though post-extubation dysphagia is a poorly-recognized health-care problem (Zuercher et al, 2019; Zuercher, Dziewas, & Schefold, 2020)
- Incidence can be as high as 80% in the literature, though in ICU patients, it is approximately 60% (Black et al, 2021; Brodsky et al, 2017; Wallace & McGrath, 2021)
  - 50% of ICU patients with PED aspirate (Brodsky et al, 2017)
  - 36% of patients with PED aspirate silently (McIntyre et al, 2021)
- Pathophysiology (Black et al, 2021, Borders et al, 2019; McIntyre et al, 2022):
  - Direct injury from ETT
  - Critical illness myopathy/polyneuropathy
  - Reduced respiratory capacity due to physical illness
  - Impaired cognition
  - Impaired laryngopharyngeal sensation/laryngeal pathology

How long is too long?

- How long would you say is prolonged intubation?

A. 3-8 hours

B. 8-26 hours

C. 27-48 hours

D. 49-72 hours

E. 96+ hours

PED: Risk factors

- **ETT Length**: 24-48 hours seems to be common consensus as to when intubation becomes prolonged (Ajemian et al, 2001; Brodsky, Nollet, Spronk, & Gonzalez-Fernandez, 2020; Plowman et al, 2023; Skoretz, Flowers, & Martino, 2010; Wallace & McGrath 2021)
  - "It should be noted that risk of TVF paralysis increases two-fold in patients whose trachea is intubated for 3-6 hours and 15-fold in patients whose trachea is intubated for 6 hours or more" (Wallace & McGrath, 2021)
  - 53% of patients with PED were intubated for less than 48 hours (McIntyre et al, 2022)
  - Altered laryngeal sensation has a profound effect on patients with a short length of intubation, likely due to impact of ETT on swallow physiology (Borders et al, 2019)
- **ETT size:** 8 or more was significantly associated with overall aspiration (Krisciunas et al, 2020; Plowman et al, 2023)
  - Larger size also associated with increased risk of laryngeal granulation tissue
- **Reintubation** is also a significant risk factor for dysphagia (Barker et al, 2009; Macht, Wimbish, & Clark, 2011)
- **Age**: 55-65 years or older is a risk factor for PED (Ponfick et al, 2015; Tsai et al, 2016)
- **ICUAW** can trigger PED (Kim, Park, & Song, 2015); 91% of patients with PED present with dysphagia (Ponfick et al, 2015)

PED: An area of concern

- PED occurs in a wide variety of patient populations, including respiratory/lung, pneumonia, cardiac, cancer, ETOH-related, overdose, MVA/stabbing, sepsis, spinal surgery, and patients with a mix of diagnoses (Scheel et al, 2016), and ARDS (Brodsky et al, 2017); dysphagia is not solely isolated to neurological populations (Kim, Park, & Song, 2015)

- Of patients evaluated post extubation (Scheel et al, 2016):
  - **57.6% penetrated/aspirated** when evaluated within less than or equal to 24 hours
  - **60% penetrated/aspirated** when evaluated after 24 hours

- PED results in **increased length of stay, hospital costs, and mortality** (Black et al, 2021) . It **persists until ICU discharge in over 80% of patients**, and in over 60% at time of hospital discharge (Zuercher et al, 2019)
  - PED is not always transient: for patients who stayed in ICU for 8 days, 75% of them required 12 months to recover from dysphagia. For patients with ICU LOS of 18 days, 75% required 12 months to recover from dysphagia (Brodsky et al, 2017)
  - Most patients recover within 6 months of discharge, but dysphagia symptoms may persist as long as 5 years after discharge.

- **Rates of pneumonia are higher in patients with PED** versus those without (21% versus 9%,), as was per patient admission cost increase (patients with PED had a 105% cost increase to the health service) (McIntyre et al, 2022)

- In elderly patients who survive critical illness, those with dysphagia at discharge are approximately **4x more likely to be readmitted within 30 days** (Brodsky et al, 2017).

Dysphagia/Dysphonia After Lung or Heart Transplant

- There is 70% incidence of dysphagia in patients following lung transplant; (Black et al, 2021), though more recent work reported unsafe swallowing in 100% of patients following lung transplant (Dallal-York, Croft, Anderson, et al, 2022)
- In patients with no pre-existing dysphagia, 84% had unsafe swallowing after lung transplant. Of those who aspirated, 47% aspirated silently (Dallal-York, Croft, DiBiase et al, 2022); other work showed 72% aspirated silently (Dallal-York, Croft, Anderson, et al, 2022)
- Silent aspiration is reported (cause known) to be as high as 77% in lung transplant patients (Black et al, 2021)
  - There is a 29% incidence of ICU-acquired weakness in lung transplant patients
    - Muscle atrophy has a profound effect on inspiratory and expiratory muscles which are required for voice production and cough effectiveness. Impairment of these functions are known to be a strong predictor for both reintubation and aspiration
  - Length of intubation and number of intubations are significant predictors for referral to SLP for management of oropharyngeal dysphagia and voice complications in lung and heart transplant patients
  - Dysphagia after transplant can be of extended duration, and patient outcomes include increased LOS, ICU readmission, and increased ICU LOS
  - When patients did sense aspiration and attempted to cough/throat clear, 100% were unable to clear the aspirate (Dallal-York, Croft, Anderson, et al, 2022)
- Aspirating patients had a 2.3 higher odds of being discharged to a dependent care setting (Dallal-York, Croft, DiBiase et al, 2022)

Dysphagia secondary to cardiothoracic & cardiac sugery

- Laryngeal injury and dysphagia are known complications of cardiothoracic surgery (Miles, McLellan, Machan, et al, 2018)
  - FEES revealed that 39% of patients silently aspirated, 61% of patients experienced vocal fold paralysis, and 65% experienced laryngeal edema. 36% of patients experienced pneumonia. 24% of patients required enteral feeding at discharge.
- Surgery associated with the aortic arch is associated with a higher incidence of recurrent laryngeal nerve damage due to risk of direct manipulation (Black et al, 2021); this can impact glottic function (which in turn can impact swallowing and voice ability per McRae et al, 2020)
- Silent aspiration is a frequent complication in patients with CABG than in general surgical population (Harrington et al, 1998)

Dysphagia after cardiac & cardiothoracic surgery

- Prevalence for dysphagia after cardiac surgery can be as high as 70%, which increases risk of pneumonia, hospital cost, and risk of readmission (Hayanga et al, 2021)
  - Recent work by Plowman et al (2023) demonstrated that FEES confirmed unsafe swallowing in 94% of patients and inefficient swallowing in 52% of patients s/p cardiac surgery
  - Swallow screens are not yet validated in cardiac patients, and may have misclassified silent aspirators
    - Dallal-York, Leonard, Anderson, et al (2022) showed that the 3 oz water swallow challenge was only 63% sensitive and specific to identify instrumentally observed aspiration (meaning silent aspiration was missed in the cardiac population)
  - Risk factors include: DM, ETT size 8 or greater, prolonged intubation of 27+ hours, vocal fold paralysis due to nerve damage, intraoperative use of transesophageal echocardiography (images over 110), New York Heart Association classification III and IV, reoperation (Plowman et al, 2023; Skoretz & Rebeyka, 2009)
    i. patients with 3 or more risk factors had **16.4x higher odds of aspiration**, and patients with 4 or more risk actors had **22.4 times higher odds of aspiration**. (Hayanga et al, 2021)
    ii. aspirating patients had 2.6 higher odds of pneumonia, 5.7 higher odds of reintubation, 2.8 higher odds of death at 90 days, waited 43% longer to resume oral intake, had a mean 104 hour longer stay in the ICU, 6 day longer hospital stay, and incurred $49,372 more in hospital costs (Hayanga et al, 2021)
    iii. Patients with dysphagia have longer length if ICU stay, and higher risk of reintubation, reoperation, and postoperative atrial fibrillation (Skoretz et al, 2014)

Dysphagia & Esophagectomy?

- Barium swallows do not always reveal aspiration, and CSE cannot exclude aspiration (Lee et al, 2017)
  - VFSS revealed **32.3% of patients aspirated**, even 7-10 days *post* esophagectomy
  - Aspiration pneumonia occurs in 13.2-44% of patients s/p esophagectomy who aspirate (Lee et al, 2017; Yuen et al, 2019)
  - Vocal fold paralysis: 12.7% incidence due to recurrent laryngeal nerve injury, with incidence increasing to 45.3% if patients have three field lymph node dissection (Lee et al, 2017)
  - Operation time greater than six hours increased risk of dysphagia (Lee et al, 2017)
  - Advanced age at time of esophagectomy can also impact dysphagia (Yuen et al, 2019)
- **58.3% of patients who aspirated had not recovered normal swallow function** per 1 month follow up VFSS (Lee et al, 2017)
- Yuen et al (2019) showed that **dysphagia can be persistent six months after esophagectomy**, and with primary problems being in the pharyngeal phase
- Evangelista & Coyle (2016) note that **VFSS is recommended in cases of esophagectomy**, as VFSS not only identifies aspiration, but its cause- and can thus help SLPs identify compensatory strategies to prevent aspiration pneumonia

Dysphagia, Dysphonia, & Patient Centered Care in Tracheostomy

- 14%-24% of patients in ICU receive a tracheostomy (McMahon et al, 2023; Mills, Cuthbertson, & Michou, 2023; Pandian et al, 2019)
- Patients who undergo tracheostomy have a higher rate of aspiration (Han et al, 2022), and motor and sensory laryngeal function are altered, thus disrupting typical breath swallow cycle (McRae, 2018)
- Negative effects of tracheostomy: fear/anxiety, inability to talk, difficulty swallowing, pain, increased WOB, and trauma to trachea leading to tracheal stenosis (Newman et al, 2022), as well as extreme xerostomia, thirst, and discomfort (Sutt, Cornwall, Mullany et al, 2015)
- Inability to communicate makes patients feel powerless, misunderstood, and angry (Ninan et al, 2023); they also feel isolation and stigma (Pandian et al, 2023)
- Impaired speech is associated with increased length of ICU stay as patient's cannot participate in setting goals and overall reduced engagement (Royal College of Speech & Language Therapists, 2019: McMahon et al, 2023).

Dysphagia, Dysphonia, & Patient Centered Care in Tracheostomy

- Patients also have poor adherence to recommendations and poor satisfaction, since without ability to verbally communicate, there is a decreased exchange of diagnostic information between staff and patient (Sutt, Cornwall, Mullany, et al, 2015)
- Patients want to be "seen and heard as a whole person." This involved having their voice (Newman et al, 2022)
  - Voice restoration should be a high priority of management of adults with a tracheostomy in ICU (Newman et al, 2022; McMahon et al, 2023)
  - Eating/drinking also seen to be hugely important to patients for physical and psychological reasons (Newman et al, 2022; Brodsky et al, 2020; McMahon et al, 2023)
- Voice is valued more highly than another communication options, including AAC (Mills, Cuthbertson, & Michou, 2023)
- An inflated cuff causes total loss of voice and is debilitating for oral communication, which is one of the most negative hospital experiences for patients (Wiberg, Whitling, & Bergstrom, 2022)

We must go from a *REACTIVE* approach with SLP on the ICU to a *PROACTIVE* approach with SLP

Critical care itself has changed to a more active rehabilitation approach- so should we! (McRae, 2020; Twose, Terblanche, Jones, Firshman, Highfield, et al, 2023)

Reactive vs. Proactive SLP Role in the ICU

Reactive

- Consult SLPs only when there's a problem
- Minimal communication
- SLP is not a member of the ICU team
- Nurse Swallow Screen (inconsistent); CSE (possibly); VFSS/FEES (rare)
- No or minimal PMV use

Proactive

- Early consultation to SLPs (within 24 hours)
- SLPs participating in rounds
- SLPs are members of the ICU multidisciplinary team
- FEES & VFSS in high risk populations
- Nurse Swallow Screens on low risk populations
- Early Passy-Muir Valve use
- Tracheostomy teams

Proactive Role of SLP in the ICU

- Staffing: There should be one full time SLP for every ten beds (Faculty of Intensive Care Medicine and Intensive Care Society, 2022; McRae, 2020). They should be available at minimum 5 days a week, preferably 7 days (Royal College of Speech & Language Therapists, 2019).
  - Role of the SLP should be a protected one (e.g. dedicated to the unit), so that services can be provided with the appropriate frequency.
    - SLPs report being able to provide services more frequently when the role is protected versus unprotected (e.g. 86.1% SLPs reporting versus 37.5%, respectively) (Twose, Terblanche, Jones, Firshman, Merriweather, et al, 2023)
    - When the SLP role has dedicated funding, there is a better staff/bed ratio (1 SLP:30 beds versus 1 SLP:157 beds, respectively), though this still does not reflect recommended guidelines (Twose, Terblanche, Jones, Firshman, Highfield, et al, 2023)
- Rounds:
  - Being present on the ward and participating in rounds is helpful to facilitate improved ICU role (Cardinal, Freeman-Sanderson, & Togher, 2020)
  - Daily participation in rounds helps identify appropriate patients for SLP assessment (Turra et al, 2021), facilitates a coordinated rehabilitation approach, and sets goals (McRae et al, 2020)
-

Proactive Role of SLP in the ICU

- Speech pathologists should:
  - Be members of the multidisciplinary ICU team to help patients regain voice and swallowing (Newman et al, 2022; Ninan et al, 2023; Rogus-Pulia & Robbins, 2013).
  - Be primary experts with regard to treatment of swallowing impairments and communication disorders (Hongo et al, 2022; McRae 2018)
  - Conduct FEES/VFSS and/or videostroboscopy to identify sensory and motor problems with regard to swallowing (McRae et al, 2020)
  - Utilize impairment-based rehabilitation approaches to facilitate improved swallowing (McRae, 2018)
  - Assist patients who are intubated or tracheostomized with communication options, including use of speaking valve (McRae, 2018)
  - Provide in services and teaching to staff (Royal College of Speech & Language Therapists, 2019).

SLPs in the ICU: Best Practice (Dysphagia)

- ICU practitioners do agree there should be **standardized protocols** related to dysphagia (Spronk et al, 2022)
- All patients in the ICU should be screened for dysphagia (Zuercher, Dziewas, & Schefold, 2020; McIntyre et al, 2022)
  - **Routine screening has been shown to reduce rate of all cause pneumonia by 80% and hospital LOS by 25%**
  - Patients who are age 65 and up should receive special attention, as patients aged 55-65 or older are at increased risk of mortality (Giraldo-Cadavid, Pantoja, et al, 2020; Medeiros et al, 2016)
- Dysphagia should be detected early, and in patients who are high risk, assessed before oral intake and within 24 hours of hospital admission (Rogus-Pulia & Robbins, 2013; Hongo et al, 2022), extubation (Scheel et al, 2016), or transplant (Dallal-York, Croft, DiBiase et al, 2022)
  - **Delayed timing of SLP evaluation/therapy has been associated with poor outcomes**, including aspiration pneumonia, death, or persistent dysphagia. Specifically, every day of delay of SLP therapy initiation after extubation was associated with dysphagia or death at hospital discharge. (Hongo et al, 2022). As such, **early evaluation is warranted**.

SLPs in the ICU: Best Practice (Dysphagia)

- Instrumental assessments (**VFSS & FEES) are the gold standard** for dysphagia in the critically ill (Zuercher et al, 2019)
  - FEES is safe and can be conducted at the bedside (Zielske, 2014; McRae 2018)
  - FEES also allows for assessment of secretion management (McRae 2020)
    - Ice chip protocol can be implemented after FEES, including in patients with severe dysphagia (Pisegna & Langmore, 2018)
- Patients on high flow nasal cannula should be evaluated before eating/drinking, especially those patients who are receiving flow over 40L/min (Charlton et al, 2023)
- **Patients who are survivors of critical illness should be reassessed on ICU discharge** (Zielske et al, 2014)
  - Patients with sepsis in particular may require a more intensive evaluation/rehabilitation program

SLPs in the ICU: Best Practice (Dysphagia)

- Therapy should be based on exercise programs (Macht et al, 2013) with therapeutic exercises targeting specific physiological impairments in the 17 swallow components identified on imaging (Brodsky et al, 2020)
  - Higher intensity is associated with return to normal diet (Macht et al, 2014; Rogus-Pulia & Robbins, 2013), though number of repetitions, sets of exercises, and number of treatment sessions may vary from day to day given patient's level of tolerance and attention in ICU (Brodsky et al, 2020).
  - Treatment should be individualized for patient as there is likely not a single optimal exercise dose for each specific exercise (Krekeler, Rowe, & Connor, 2021). Ideally, exercises should be performed daily whenever possible (van Snippenburg et al, 2019; McMahon et al, 2023)

SLPs in the ICU: Best Practice (Dysphagia)

- Examples of exercises include: respiratory muscle strength training, mandibular/lip ROM, Shaker (Krekeler, Rowe, & Connor, 2021); supraglottic swallow, Mendelsohn maneuver, effortful pitch glides (Balou et al, 2019), laryngeal adduction, BOT retraction, laryngeal elevation (Turra et al, 2021), effortful swallows with ice chips (Pisegna & Langmore, 2018)
- Therapy can even be as short as 15 minutes if needed (Siao et al, 2023) in order to have positive results; though 30-60 minutes 1x/day is ideal (Turra et al, 2021; Ponfick et al, 2015).
- Exercises can result in increased recruitment of suprahyoid muscles, which prolong larynx elevation and reduce pharyngeal residue, and reduce penetration (El Gharib et al, 2019)

- Diet modification and postural techniques are also utilized, but they are compensatory strategies for what the body cannot do on its own (Brodsky et al, 2020). Historically tx focused on compensatory strategies; however, best practice is now **focusing on exercises** as well (Burkhead, Sapienza, & Rosenbek, 2007)
- Recommendations to thicken liquids should *not* be made until after imaging is performed by SLP (Nativ-Zeltzer et al, 2018), as doing so can have negative consequences (McRae, 2018)
- Patients with tracheostomy often have reduced laryngopharyngeal sensation and reduced subglottic pressures. PMV can be used to address this (Mills, Cuthbertson, & Michou, 2023), and thus facilitate improved swallow

SLPs in the ICU: Best Practice (Communication)

- Patients who are ventilated, but awake, experience communication challenges (McRae, 2018)
  - Patients prefer speech whenever possible, and this can be achieved when tracheostomy cuff is deflated
  - Speaking valves can be utilized to facilitate improved communication (Roberts, 2020)
  - Cuff deflation and placement of speaking valve enable speech and restore subglottic air pressure, which are important for effective swallowing (O'Connor et al, 2019; Mills, Cuthbertson, & Michou, 2023; McRae, 2020, Lian et al, 2022)
  - While fenestrated tubes are available, they do have complications including granulation tissue, malpositioning, decreased O2 saturation, increased blood pressure, increased peak pressures, air leakage, and subcutaneous emphysema. **They should be used only when a one way valve is not feasible** (Pandian et al, 2019)
- Recent work has shown that it is feasible to place a speaking valve within 24 hours (Martin et al, 2021), and **early PMV use should be prioritized** (Lian et al, 2022)
- Use of speaking valves is routine and now commonplace (Ceron et al, 2020;
- A post-tracheostomy electronic order set can be generated in order to trigger automated SLP consult
- **PMV use should be tried while patient is still ventilated** (Mills, Cuthbertson, & Michou, 2023), and as soon as

SLPs & Passy-Muir Valves (PMVs)

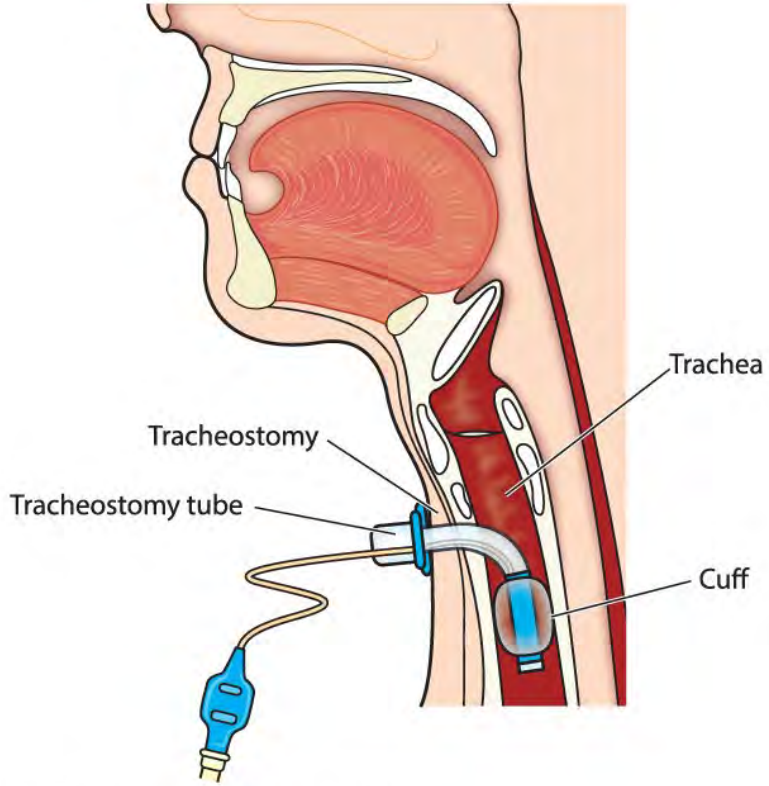
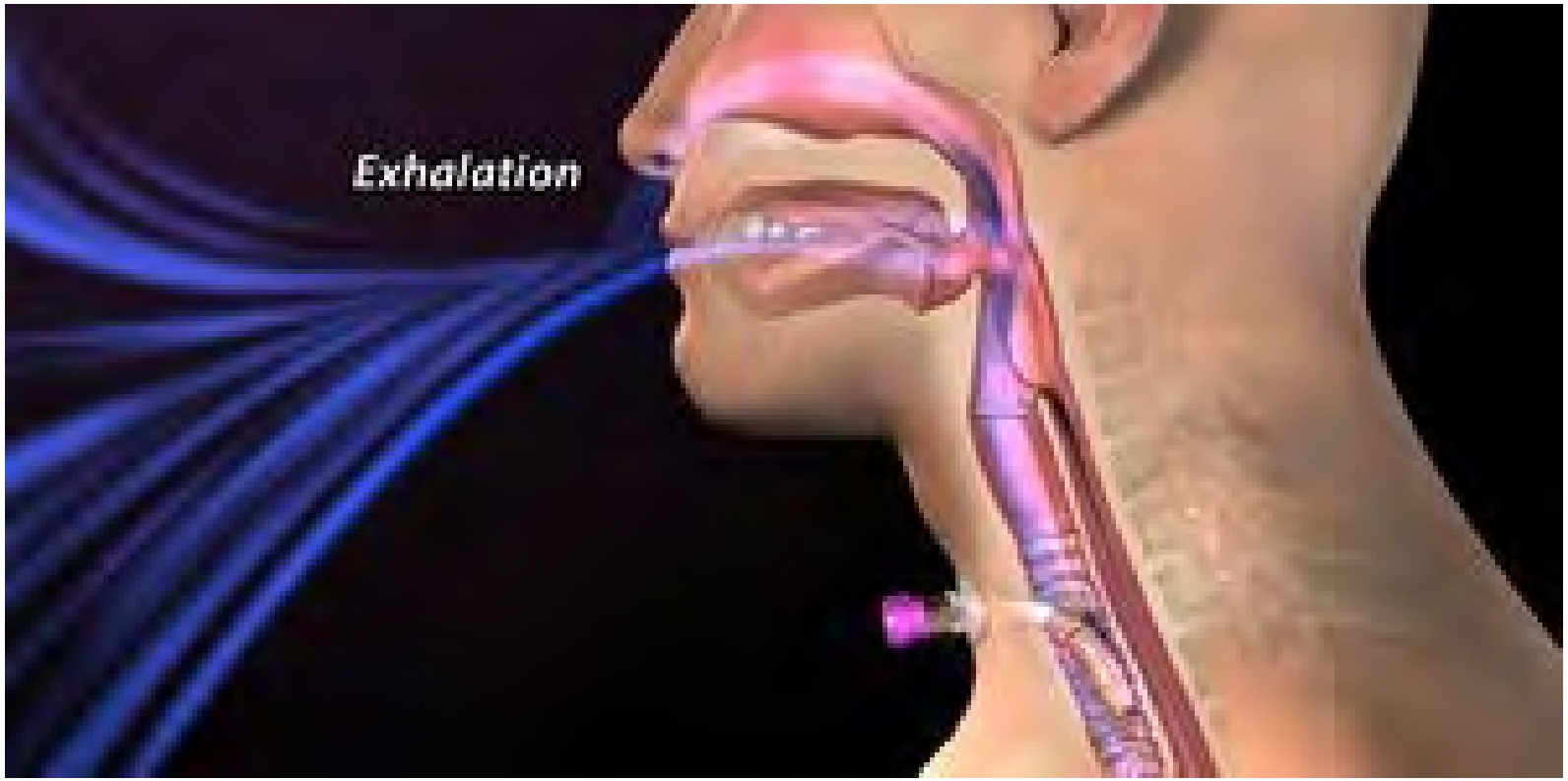


Figure 2. Cuffed tracheostomy within trachea directs airflow away from larynx and upper airway

SLPs & PMVs



SLPs & PMVs: An Evaluation

- SLP and RT collaborate to deflate cuff and place PMV to restore upper airway flow and subglottic air pressure (Burkhead, 2011; Martin et al, 2021; McRae, et al, 2020)
  - This can be done even in early phases to facilitate reflexive airway protection and swallowing function without necessarily requiring focused attention or active participation from patients
- Swallow function should be evaluated with FEES, after which progressive strengthening exercises may be gradually added (Burkhead, 2011; Rodrigues et al, 2015).
  - PMV is worn for all subsequent swallow tx if possible, with appropriate swallow exercise chosen for each physiological deficit as identified on FEES

SLPs & PMVs: Treatment

- Goal of SLP aphonia/dysphonia with PMV is to increase tolerance for PMV. Once a patient can tolerate PMV for 30 minutes straight, SLPs can work with PTs in order to have PMVs worn during tx to help facilitate improved mobility (Ceron et al, 2020)
  - Mobility can be targeted even in patients still on mechanical ventilation or with large secretion burden (Gurnari & Martin, 2011)
- If not working with PT, PMV tx is often combined with dysphagia tx (as PMV can positively impact swallow function)
  - 30 minutes or more a day. Can include supraglottic swallow, muscle strengthening exercises, Mendelsohn maneuver (Han et al, 2022)
  - Therapy should be daily ideally (McMahon et al, 2023)
  - Once patients can wear PMV for 2 hours straight or more, it is safe for them to begin wearing it for prolonged periods (O'Connor, Morris, & Paratz, 2020)

Perspective: Early PT vs. Early SLP

Ambulation

1.Leg strength/ROM
2.Standing, balance
3.Few steps
4.Greater distance/speed
5.Variety of terrain

Swallowing

1. Oropharyngeal/laryngeal strength/ROM
2. Dry swallow, cough/ breath hold
3. Few bites/sips
4. Greater volume/rate
5. Variety of consistency/situation

SLPs on Tracheostomy Teams: Best Practice

- Members of a team include: SLP, MD, RT, nurse and advanced practice providers (Pandian et al, 2023; Davis et al, 2021)
- Team conducts rounds with decisions made towards reducing safety threats, determining time for PMV placement and diet initiation, identifying patients for tube downsize/decannulation, and discharge planning (Ninan et al, 2023; Davis et al, 2021)
  - Rounds can be 1x, 2x, 3x week, or even daily
- Should have tracheostomy tracking and following system as well as decannulation protocol
- SLPs provide their expertise with regard to communication management, dysphagia management, laryngeal function assessment, and secretion management to assist with discussions for weaning/decannulation (Wiberg, Whitling, & Bergstrom, 2022)

Benefits of SLP on the ICU

- Judicious use of imaging allowed for:
  - Appropriate use of thickened liquids resulting in low incidence of aspiration pneumonia (4.8%) within six months (Masuda et al, 2022)
- Blanket referral allowed for:
  - PED to be identified in 89% of patients
- Early rehabilitation allowed for:
  - Early dysphagia rehabilitation allowed for decreased incidence of severe dysphagia (80% pre therapy; 6.7% post therapy) (per el-Gharib et al, 2019)
  - PMV improved early mobility (Roberts, 2020; Ceron et al, 2019; Gurnari & Martin, 2011)

Benefits of SLP in the ICU

- Early PMV use, reduced time to decannulation, and decreased adverse events and hospital LOS (Ninan et al, 2023; Martin et al, 2021)
  - Gurnari & Martin (2011) specifically showed improvement ventilator weaning rates by 13% over 1.5 years
  - Sutt & Fraser (2015) showed increase in PMV use from 0% of patients to 70% of patients in a 3 year period
- Early PMV use with SLP resulted in decreased use of modified diets (fluid modification) (Sutt, Cornwell, Mullany, et al, 2015)
- Early PMV use likely led to improved lung recruitment (Sutt, Caruana, Dunster, Cornwell et al, 2016)
- Independent use of PMV or with family (43% of patients in early placement versus 16/7% in standard arm (Martin et al, 2021)
- Improved communication and quality of life (Ninan et al, 2023)
- Improved secretion management and ventilation (O'Connor, Morris, & Paratz, 2019; Gurnari & Martin, 2011; Lichtman et al, 1995)
- Improved communication, improved psychosocial wellbeing, increased involvement in care decisions (McRae et al, 2020); Decreased anxiety and improved patient satisfaction (Gurnari & Martin, 2011)
- Increased use of swallow exercises, which in turn resulted in reduced swallowing-related medical complications, chest infections, and death or nursing home admission in comparison to those receiving usual care (Macht et al, 2014), as well as increased return to oral feeding (Rodrigues et al, 2015; Sutt, Cornwell, Mullany, et al, 2015; Turra et al, 2021)
- Improved communication and swallowing with PMV, particularly due to improved subglottic pressure and associated improved airway protection (Han et al, 2022)
- Reduced risk of aspiration pneumonia and improved cost effectiveness (Rogus-Pulia & Robbins, 2013; Hongo et al, 2022)

Benefits of SLP in the ICU

- SLP participation on tracheostomy team resulted in improved decannulation (Davis et al, 2021)
- SLP participation on tracheostomy team allowed for (Ninan, et al, 2023):
  - 14-275% increase in speaking valve use
  - 33-73% reduction in median days to speech
  - 26-32% reduction in days to decannulation
  - 32-88% reduction in rate of adverse events
  - 8-14 day reduction in median length of hospital stay

Future Possible Benefits of SLP Involvement in ICU

- Reduced hospital cost/LOS:
  - Dysphagia found to increase hospital LOS by 3 days on average, with cost of up to $10,438.41 per visit (Clayton et al, 2024). Early SLP diagnosis and dysphagia tx may decrease this.
  - Dysphagia increased healthcare expenditure per episode of care by 93%, ICU LOS (154 hours versus 53 hours), and hospital LOS (20 days versus 8 days) in comparison to patients without dysphagia. Early SLP diagnosis and tx may reduce this. (McIntyre et al, 2022)
  - Pandian et al (2019) already saw cost savings.
- Reduced negative sequelae of tracheostomy
  - Early restoration of subglottic pressure and laryngopharyngeal airflow may improve short and long term sequelae of tracheostomy (Mills, Cuthbertson, & Michou, 2023)
- Early return to phonation (Pandian et al, 2019).
- Reduced likelihood of chronic dysphagia (Rogus-Pulia & Robbins, 2013; Hongo et al, 2022)
- Reduced likelihood of pneumonia (McIntyre et al, 2022)

In Conclusion:

- Skills and expertise of SLPs in the area of swallowing function, language, and communication add great value to the existing multidisciplinary team in critical care (McRae, 2020)
- SLPs have a unique role to play in the ICU with communication restoration, FEES/VFSS diagnostics, and one way valve use (Twose et al, 2021)

One final question:

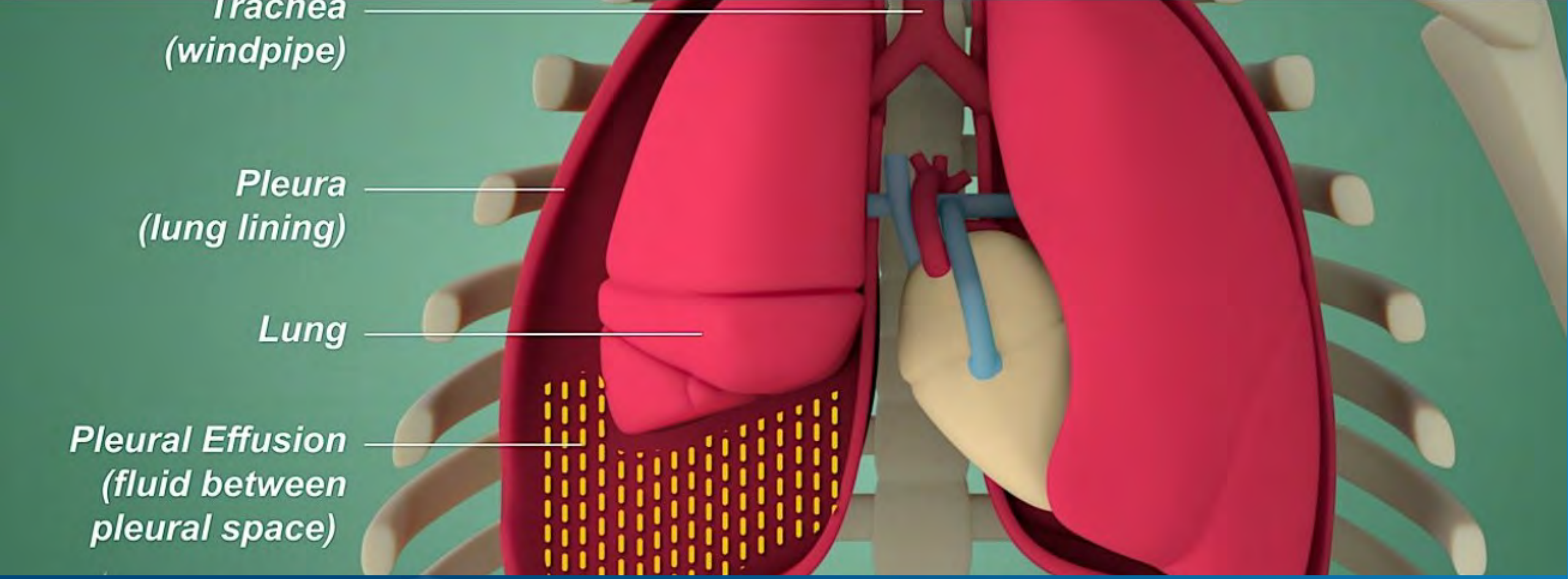
Will you advocate for increased SLP involvement in your ICU?

Thank you!

Evaluation of Recurrent Pleural Effusions

Scott Oh, DO
Professor
UC Los Angeles

Dr. Scott Oh completed a Pulmonary and Critical Care Fellowship at Cedars-Sinai followed by Interventional Pulmonology training at Harvard. Dr. Oh returned to UCLA where he served as Section Chief and founded an Interventional Pulmonology Fellowship for which he served as Program Director as well as established a weekly web-based IP core curriculum. His research initially focused on DNA repair mechanisms and tumor stem cells in malignant pleural effusions. His current interests include lung cancer and the development of medical devices to facilitate the diagnosis and treatment of malignant and benign diseases of the chest.



California Thoracic Society
ATS Chapter

RECURRENT PLEURAL EFFUSIONS

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AGENDA

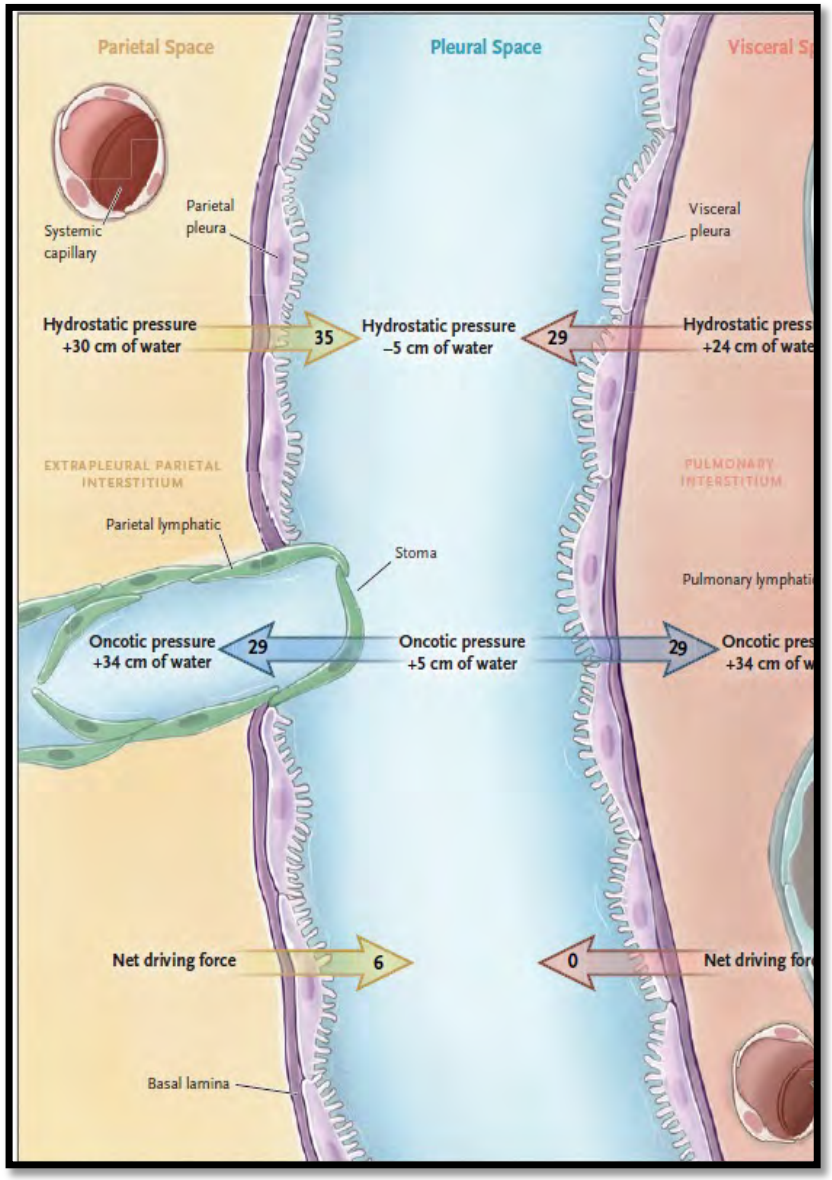
Background

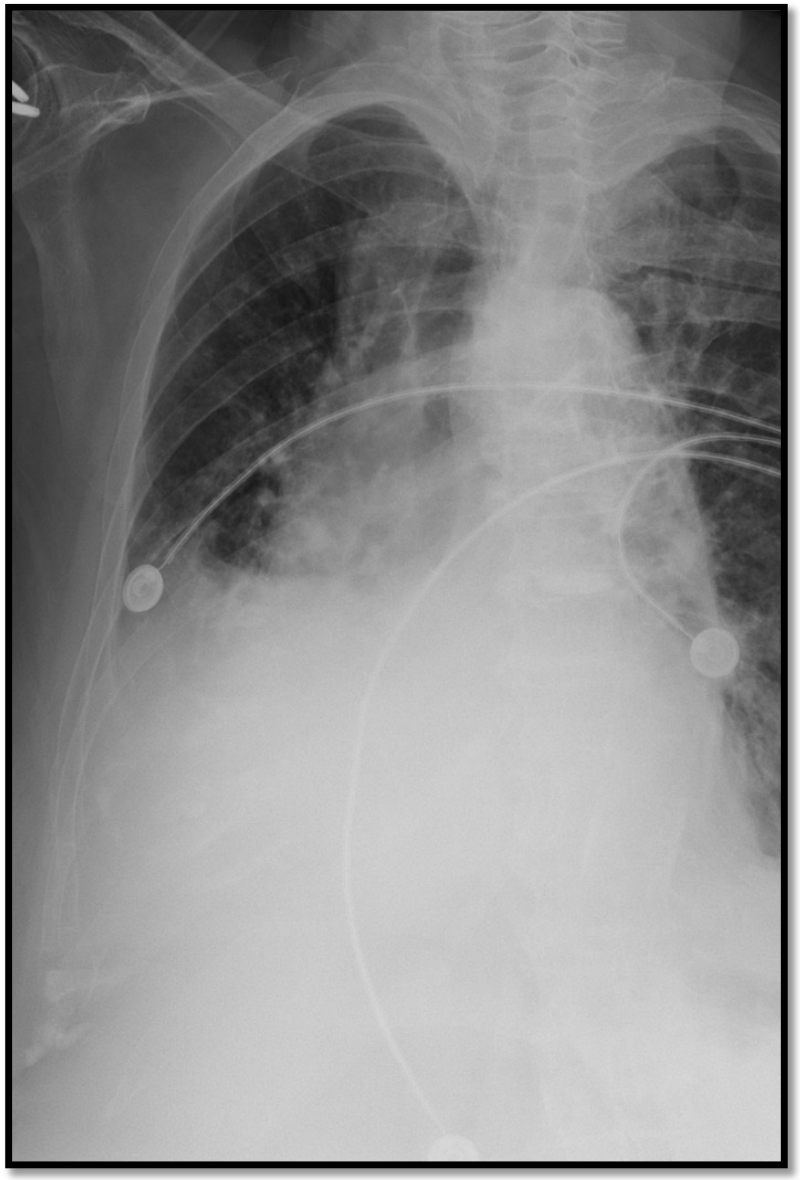
Physiology

Differential Diagnosis

Diagnostic Approach

Summary





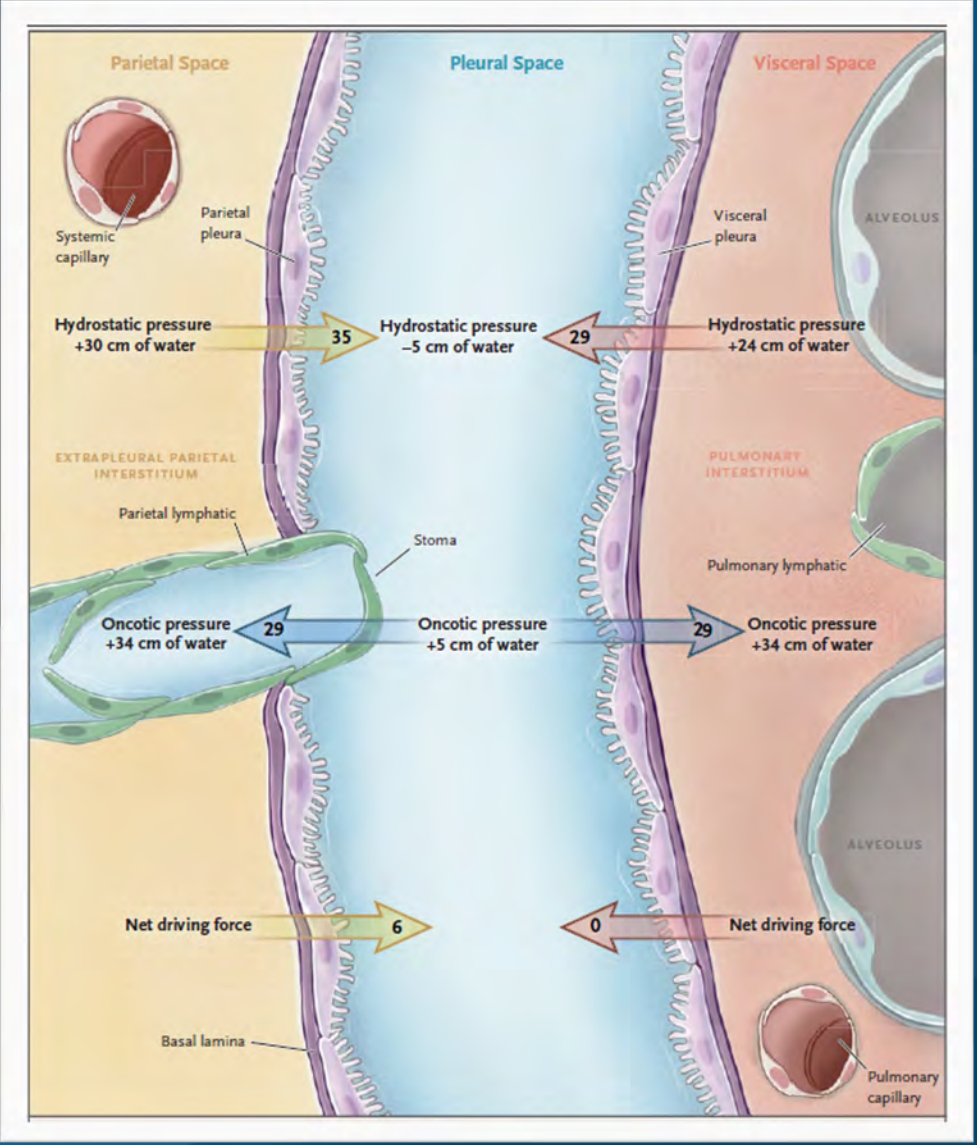
UCLA Health

PLEURAL DISEASE EPIDEMIOLOGY

- 42,215 ED visits = 286 million
- 361,270 hospitalizations = 10.4 billion
  - 284,000/d x 100 years

1. Non-malignant pleural effusion
2. Malignant pleural effusion
3. Empyema

Mummadi SR, Stoller JK, Lopez R, Kailasam K, Gillespie CT, Hahn PY. Epidemiology of Adult Pleural Disease in the United States. Chest. 2021;160(4):1534–51



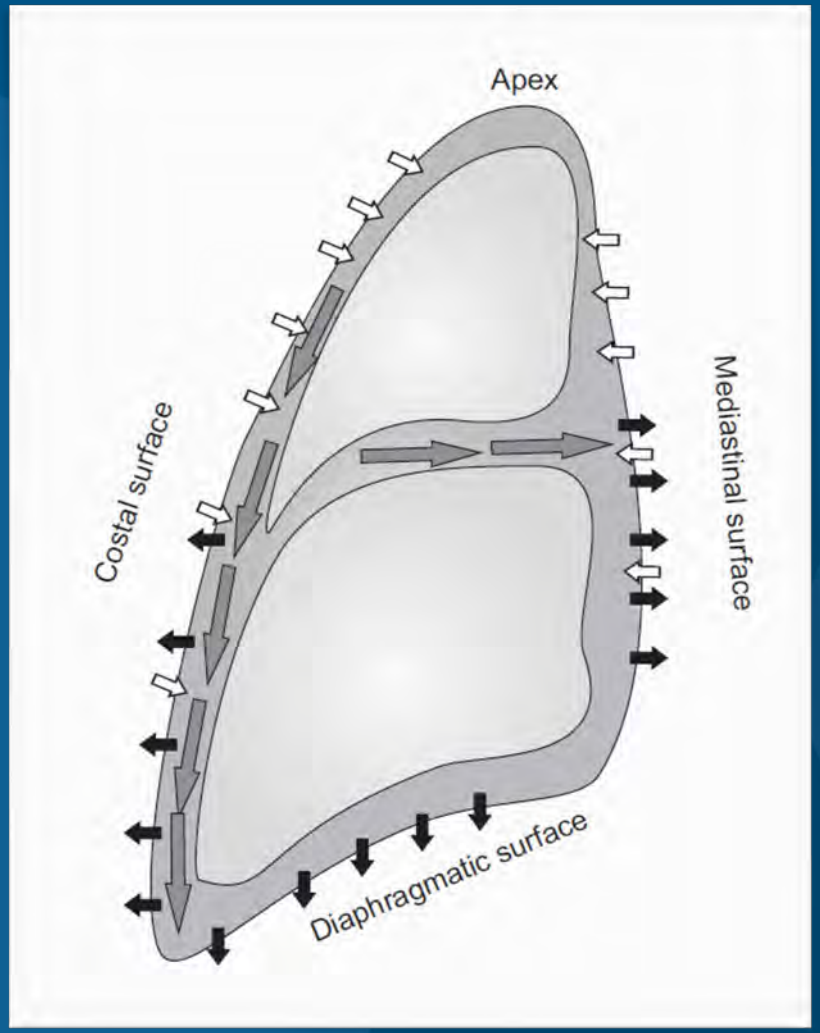
- Parietal Pleura:
  1. Hydrostatic = Oncotic
  2. Net force = 0 cm H2O

- Visceral Pleura:
  1. Hydrostatic > Oncotic
  2. Net force = 6 cm H2O

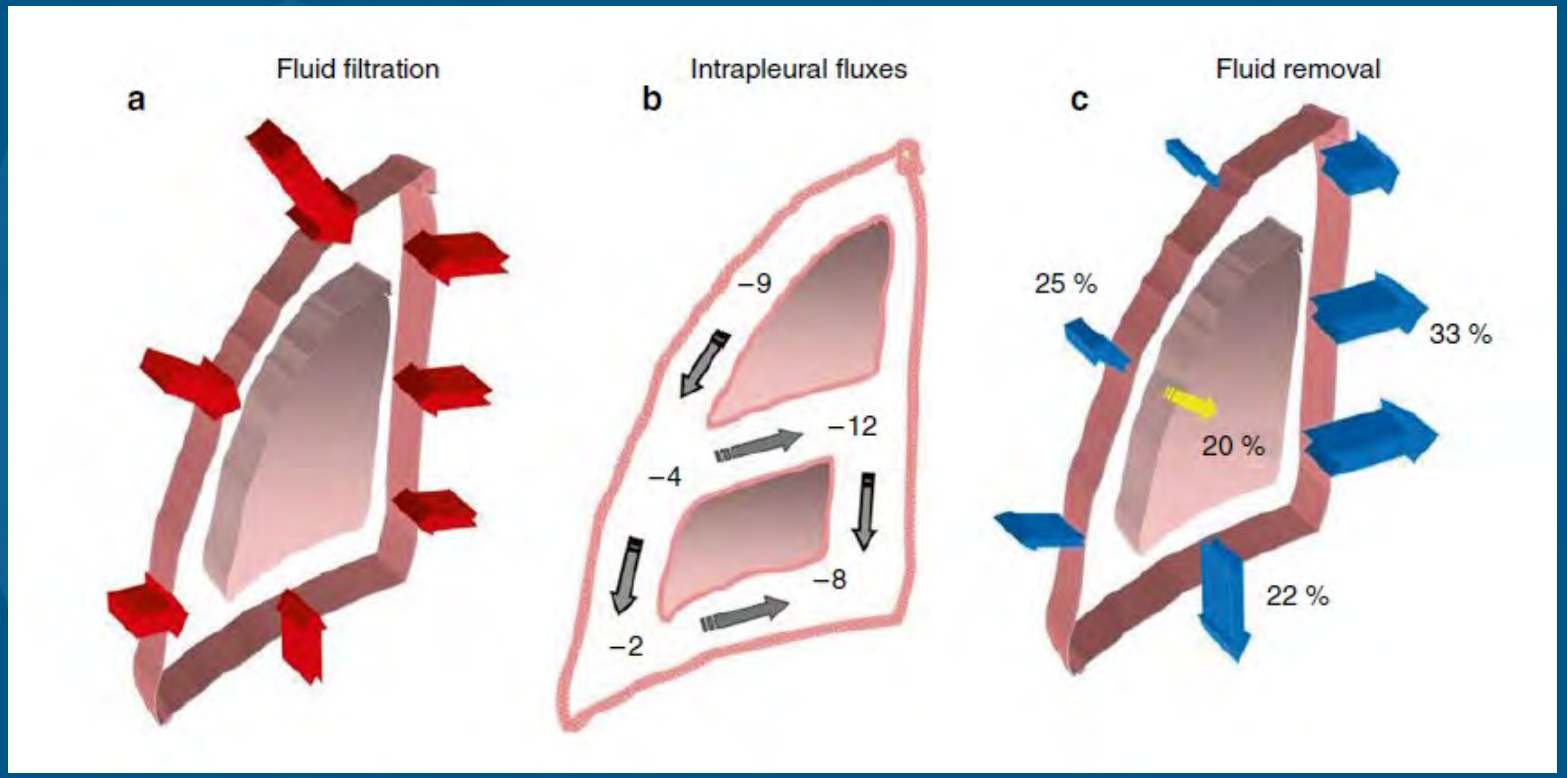
→ Formation: Primarily Parietal Pleura
  → Higher hydrostatic pressure

→ Absorption: Primarily Parietal Pleura
  → Lymphatics

Feller-Kopman, D., & Light, R. (2018). Pleural Disease. New England Journal of Medicine, 378(8), 740–751
Astoul, P., Tassi, G., & Tschopp, J.-M. (Eds.). (2014). Thoracoscopy for Pulmonologists. Springer Berlin Heidelberg



1. 0.26 mL/kg (18 mL)
2. 5 – 100 µm layer
3. 0.02-0.09 mL/hr*kg (150 mL/d)



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LIGHT'S CRITERIA

Cholesterol > 55 mg/dL

LDH > 0.67 ULN

Protein > 3.0 g/dL

Pleural Effusions: The Diagnostic Separation of Transudates and Exudates

RICHARD W. LIGHT, M.D., M. ISABELLE MACGREGOR, M.D.,
PETER C. LUCHSINGER, M.D., F.A.C.P., and WILMOT C. BALL, JR., M.D.,
Baltimore, Maryland

In this prospective study of 150 pleural effusions, the utility of pleural-fluid cell counts, protein levels, and lactic dehydrogenase (LDH) levels for the separation of transudates fr

oratory studi
agnostic aid,
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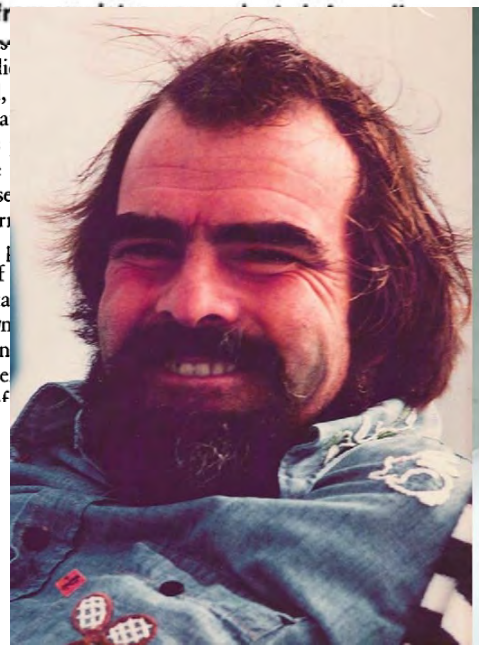
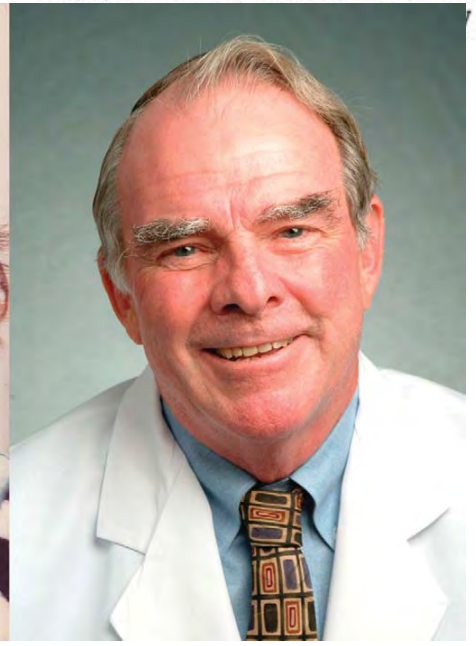
A pleural-fluid protein level of 3.0 g/100 ml is frequently used to separate transudates from exudates; however, this dividing line has consistently effusions. Carr





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“"Pleural effusions are like tides in the ocean of the lungs. With the right care, they can recede." - Dr. Maya Angelou”

DR. MAYA ANGELOU

- Total protein
- LDH
- Glucose
- Cholesterol
- pH
- Fungal/AFB/Gram stain/cultures
- Cell count/differential
- Cytology

Volume

Hydrostatic

Oncotic

Heart Failure

Liver Disease

Renal Disease

Low Protein

Malignant

Metastatic

Primary Pleural

Lung

Breast

Intra-abdominal

Other

Misc

Infection (TB, bacterial, fungal)

CT disease (SLE, RA)

Chylous

Infarction

Peritoneal dialysis

Fistulas

Inflammatory

& Trauma

Pancreatic

Esophageal

Genitourinary

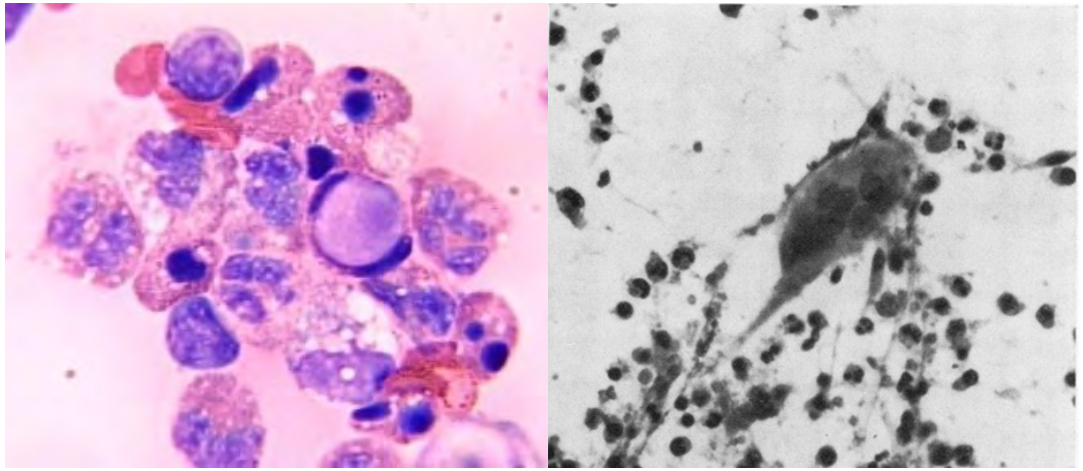
CNS

Bladder

Hepatobiliary

- Albumin
- Adenosine deaminase
- Tadpole cells (cytology)
- Lupus erythematosus cells (cytology)
- Flow cytometry
- Amyloid

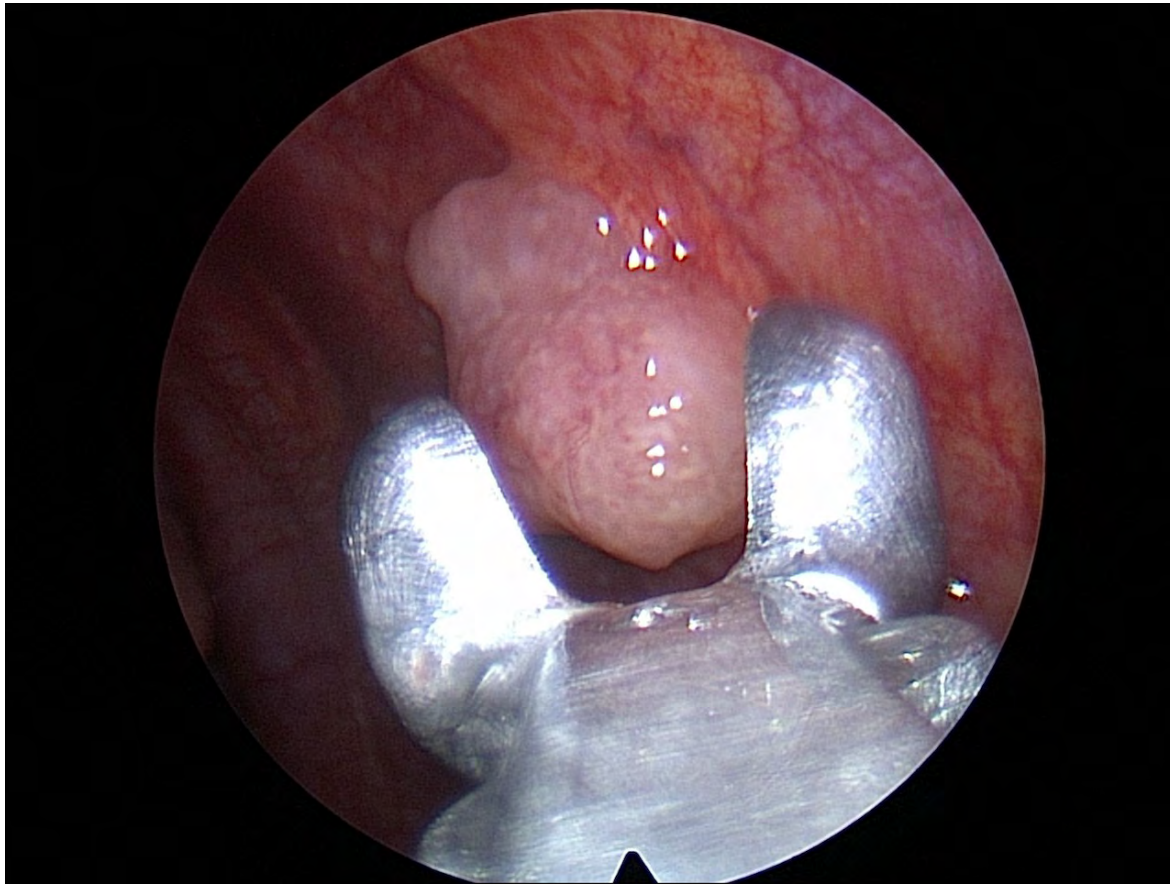
- Creatinine
- Beta-2-transferrin
- Amylase (salivary)
- Amylase (pancreatic)
- Bilirubin



PLEURAL EFFUSIONS AND CANCER

- 22% of pleural effusions are malignant
- >150,000 cases per year
- MPE vs. paramalignant
- Symptomatic MPE

1. Breast cancer 50%
2. Lung cancer 25%
3. Mesothelioma >90%



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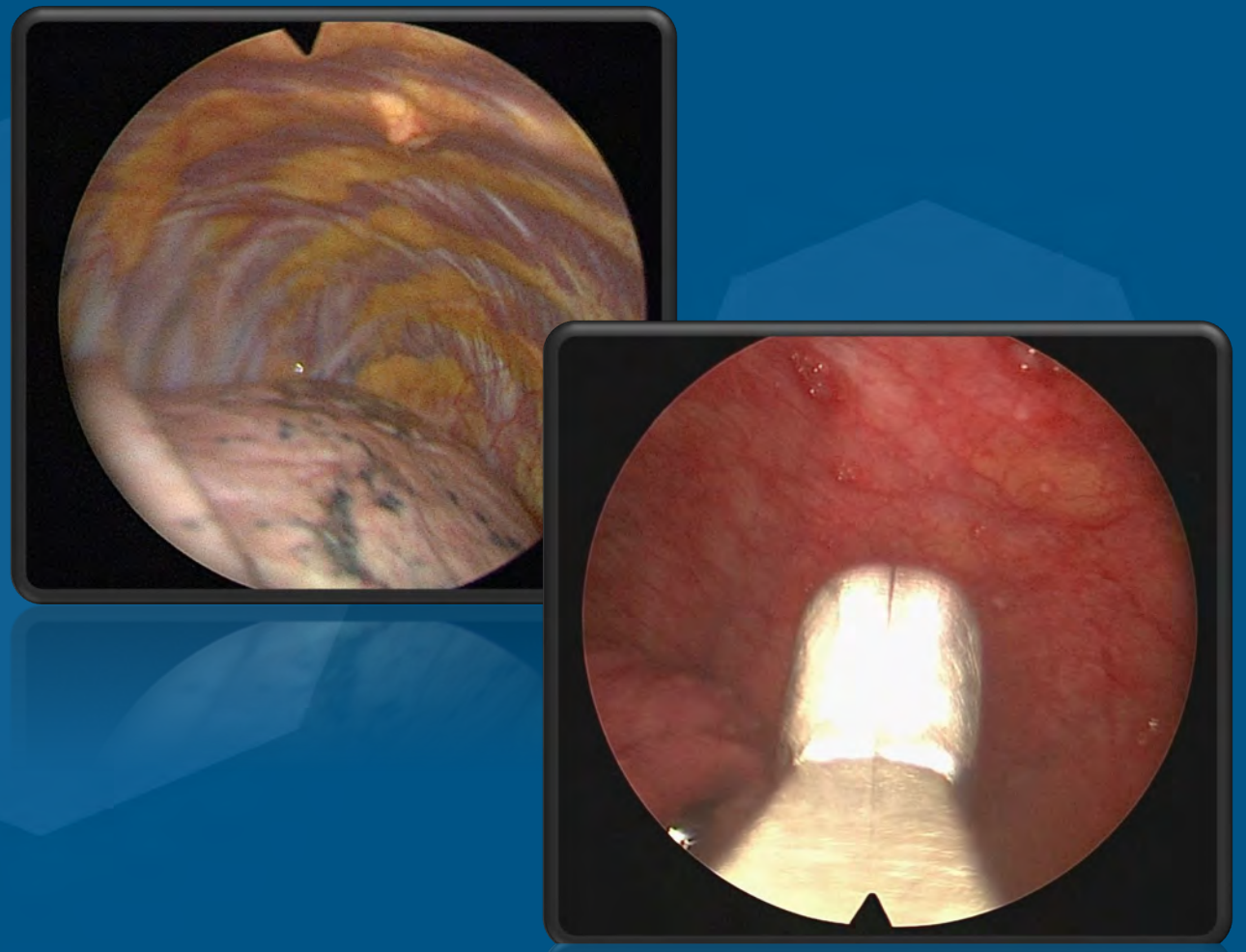
MALIGNANT PLEURAL EFFUSION DIAGNOSIS

- Thoracentesis diagnostic yield
  1. 65%
  2. 27%
  3. 5%
- Mesothelioma
  1. Cytology 26%
  2. Closed biopsy + cyto 39%
  3. Pleuroscopy 98%
- 1-6.8% MPE transudates
- Pleuroscopy for undiagnosed exudates
  1. Diagnostic yield >90% for MPE



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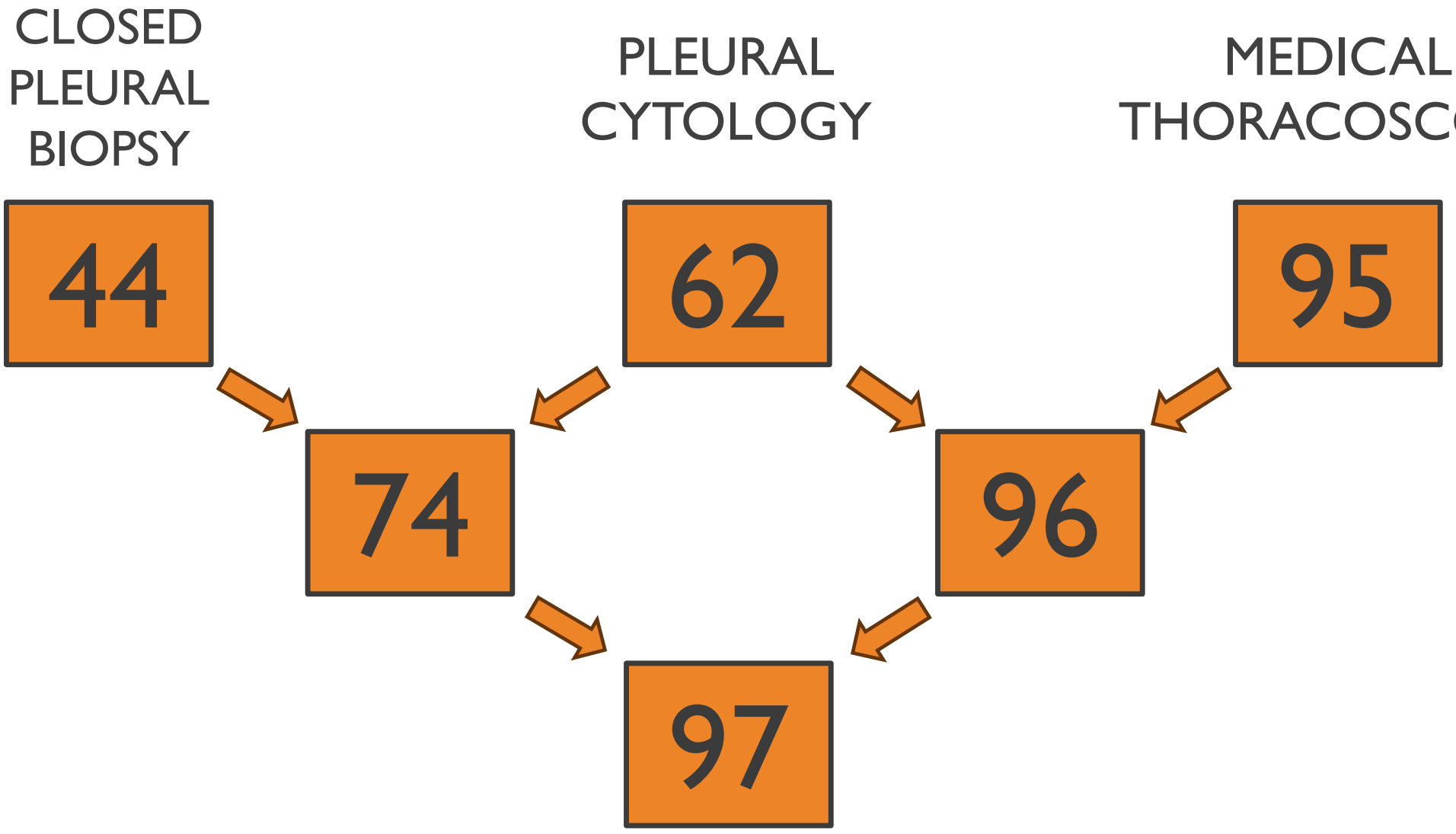
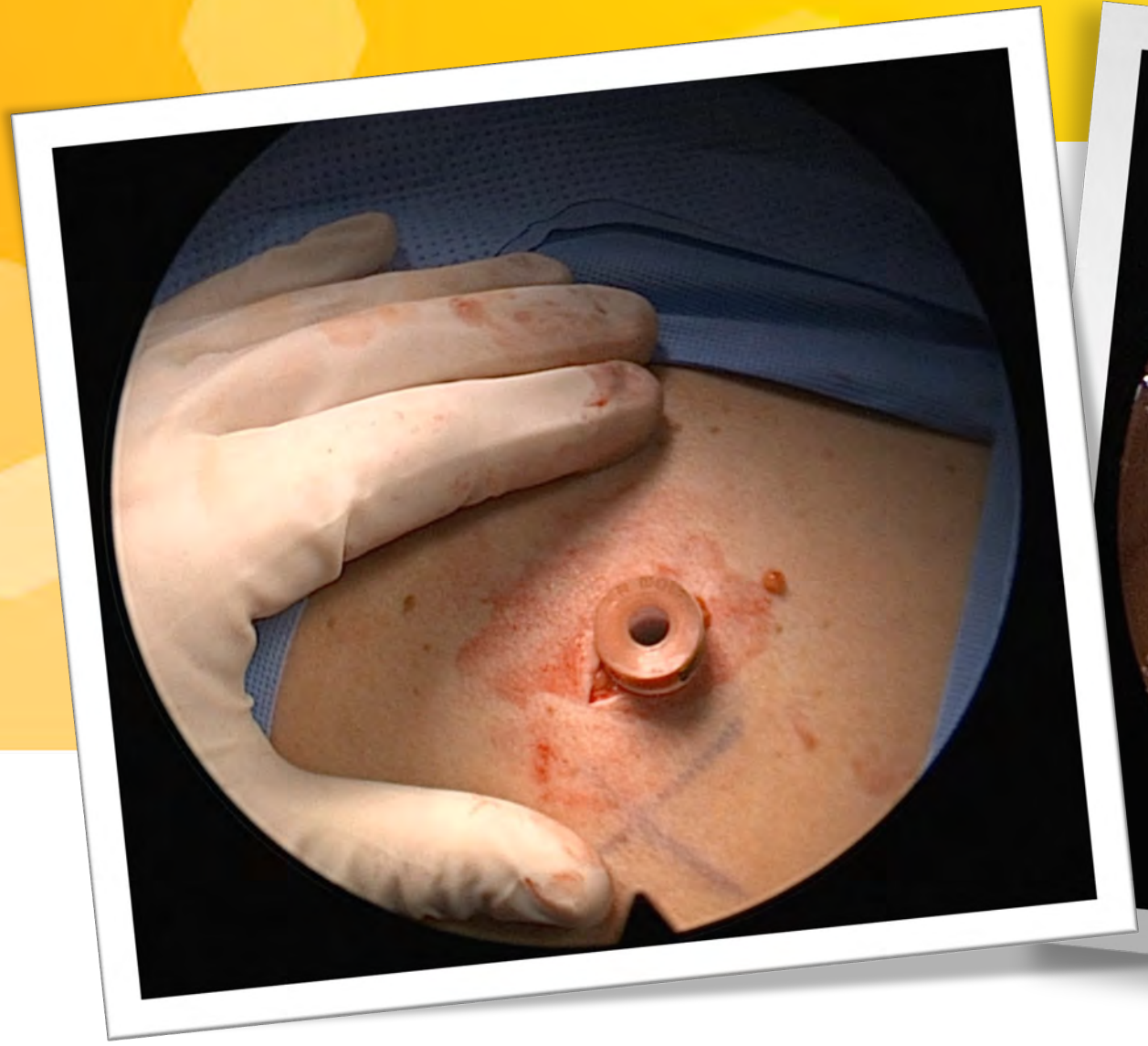
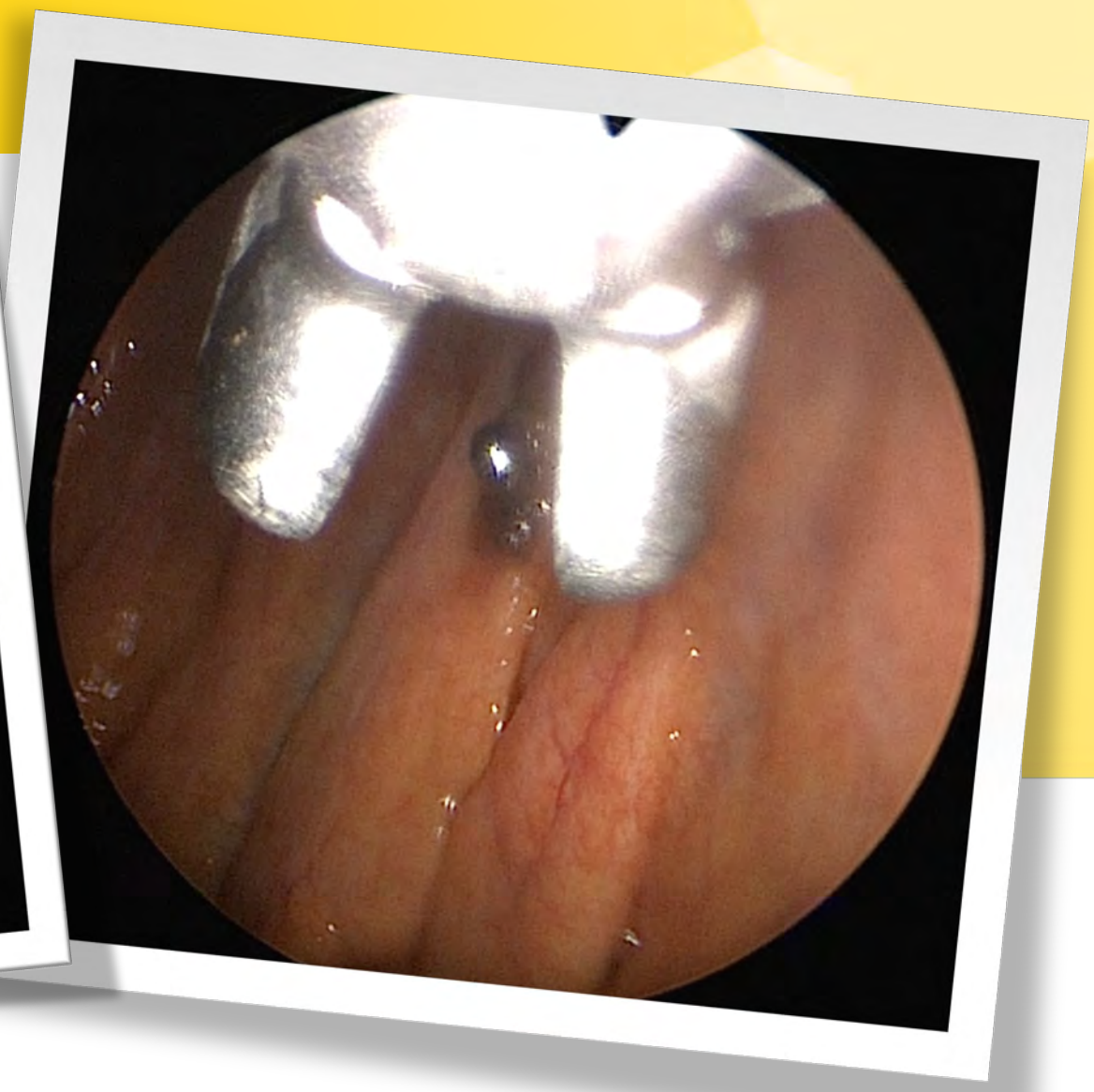


Loddenkemper R, Grosser H, Gabler A, Mai J, Preussler H, Brandt HJ. Prospective evaluation of biopsy methods in the diagnosis of malignant pleural effusions: intrapatient comparison between pleural fluid cytology, blind needle biopsy and thoracoscopy. Am Rev Respir Dis 1983





UCLA Health

Role of early definitive management for newly diagnosed malignant pleural effusion related to lung cancer

KA-YAN CHIANG,[1] JAMES CHUNG-MAN HO,[1] PEONY CHONG,[1] TERENCE CHI-CHUN TAM,[1] DAVID CHI-LEUNG LAM,[1] MARY SAU-MAN IP,[1] YUN-CHOR GARY LEE[2,3,4] AND MACY MEI-SZE LUI[1]

- Restrospective
- N = 127 with driver mutations
- MPE control (TIPC or chemical pleurodesis)
- Early definitive management + systemic — 76.5% with MPE control
- Systemic therapy alone — 46.2% with MPE control

Chiang, K.-Y., Ho, J. C.-M., Chong, P., Tam, T. C.-C., Lam, D. C.-L., Ip, M. S.-M., Lee, Y.-C. G., & Lui, M. M.-S. Role of early definitive management for newly diagnosed malignant pleural effusion related to lung cancer. Respirology. 2020

RESTROSPECTIVE, N = 280, SYMPTOMATIC MPE

[Thoracic Oncology Original Research]

CHEST

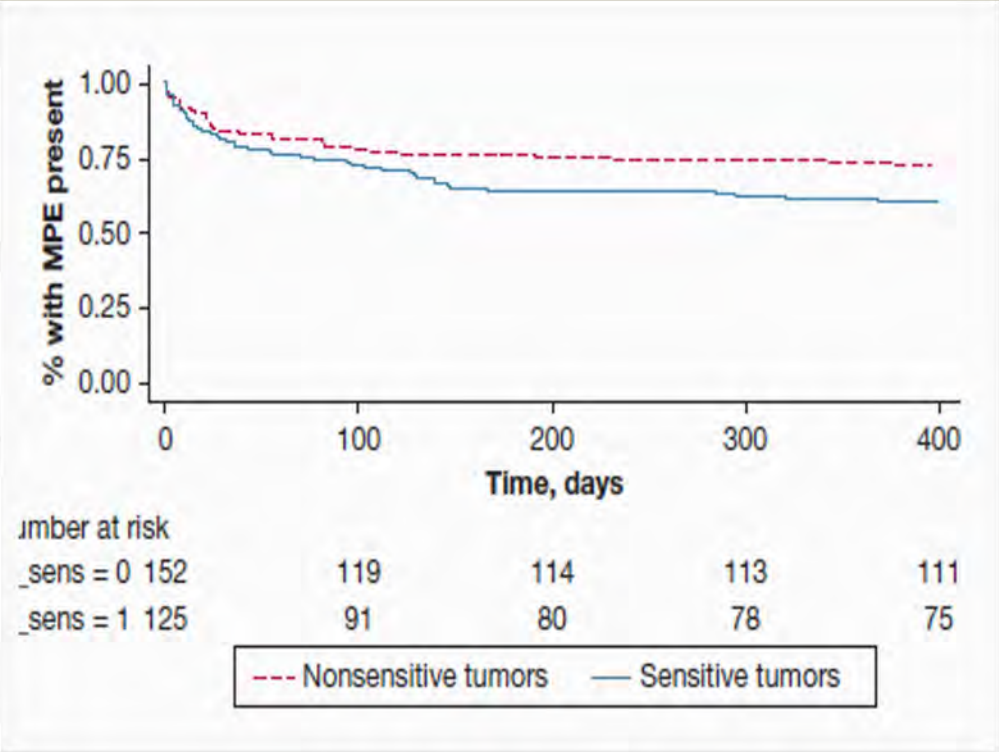
Is Systemic Anticancer Therapy Associated With Higher Rates of Malignant Pleural Effusion Control in People With Pharmacologically Sensitive Tumors?

A Retrospective Analysis of Prospectively Collected Data

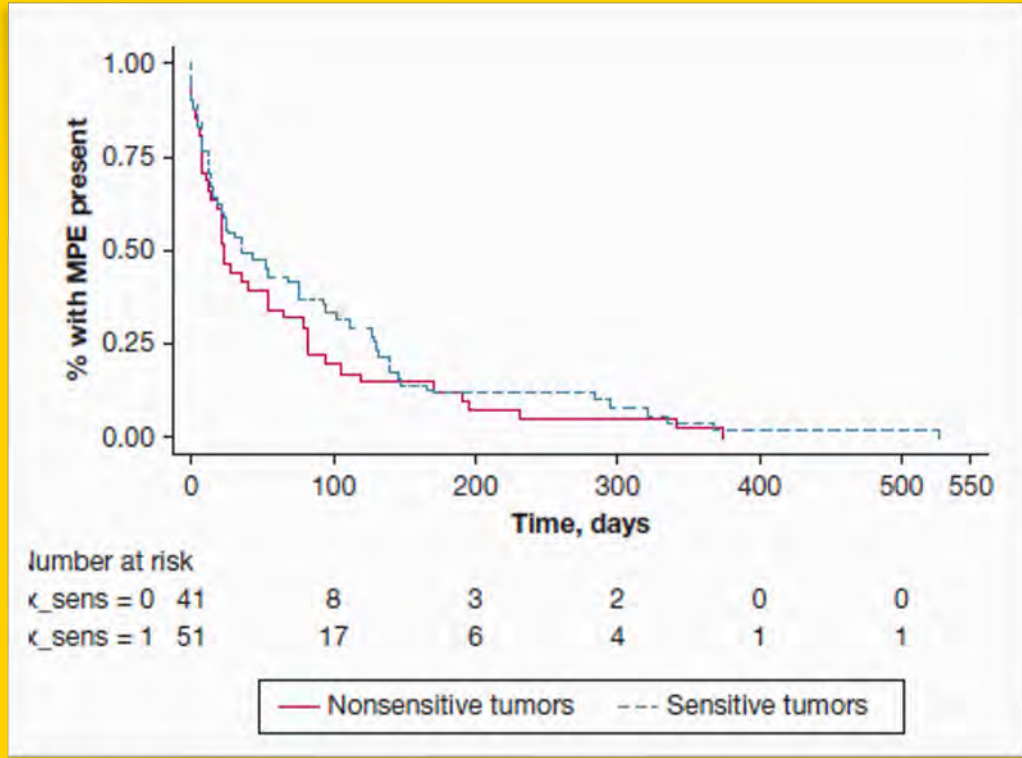
Nina Holling, MBChB; Sonia Patole; Andrew R. L. Medford, MBChB; Nick A. Maskell, BM BS; and Anna C. Bibby, MBChB

Holling, N., Patole, S., Medford, A. R. L., Maskell, N. A., & Bibby, A. C. Is Systemic Anticancer Therapy Associated With Higher Rates of Malignant Pleural Effusion Control in People With Pharmacologically Sensitive Tumors? Chest 2021

MPE RESOLUTION



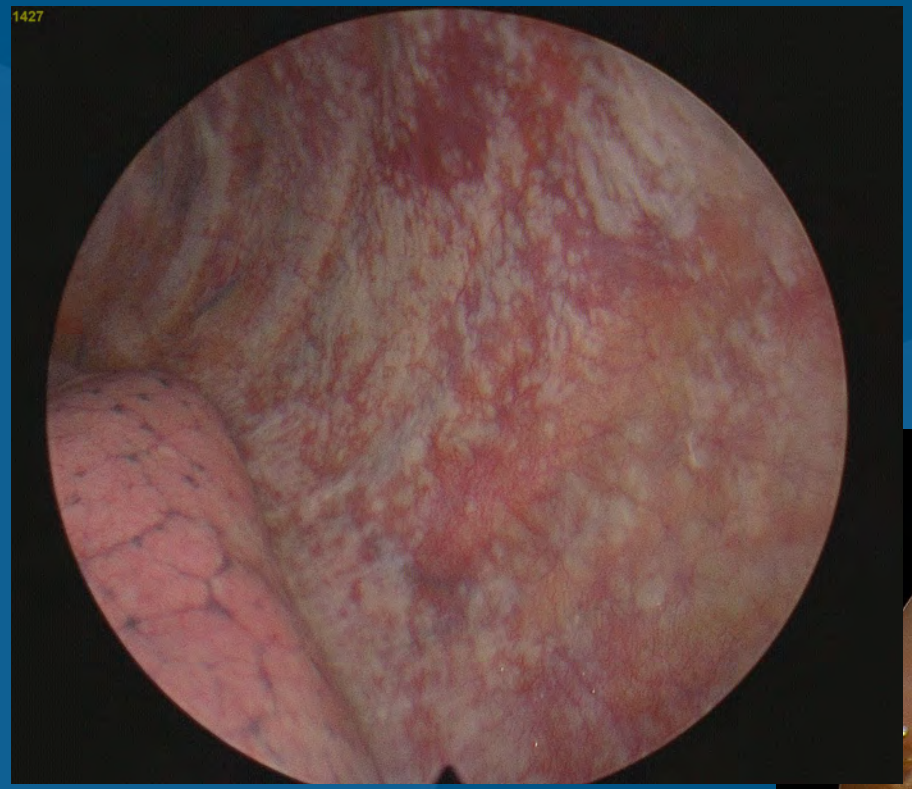
MPE Resolved ∝ Tx Sensitivity



- Hematologic malignancies
- Ovarian

Holling, N., Patole, S., Medford, A. R. L., Maskell, N. A., & Bibby, A. C. Is Systemic Anticancer Therapy Associated With Higher Rates of Malignant Pleural Effusion Control in People With Pharmacologically Sensitive Tumors? Chest 2021

UCLA Health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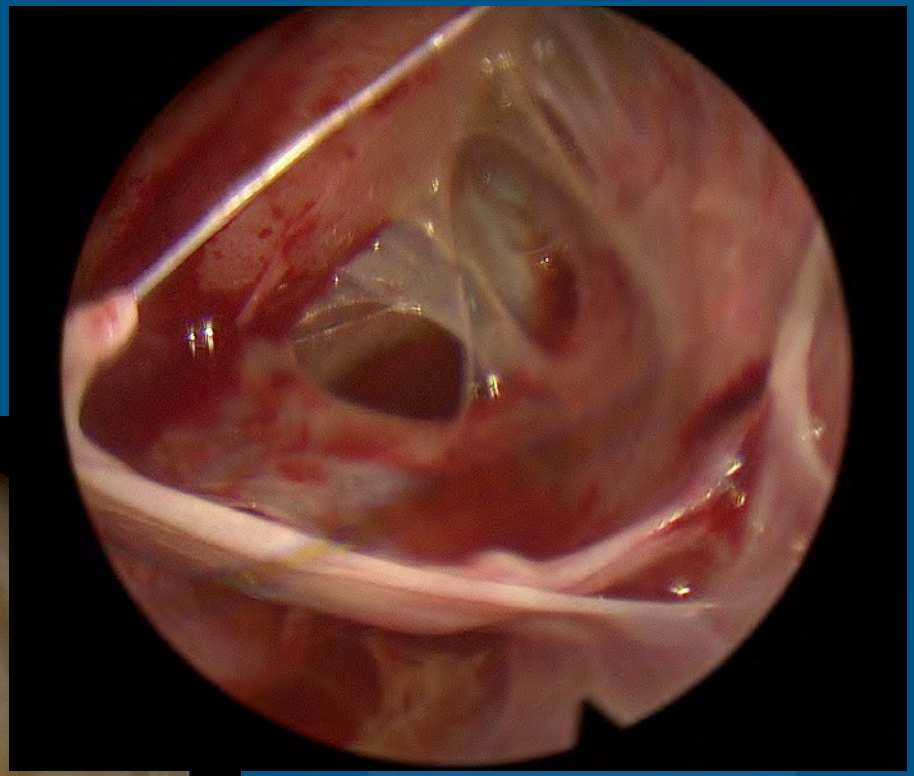

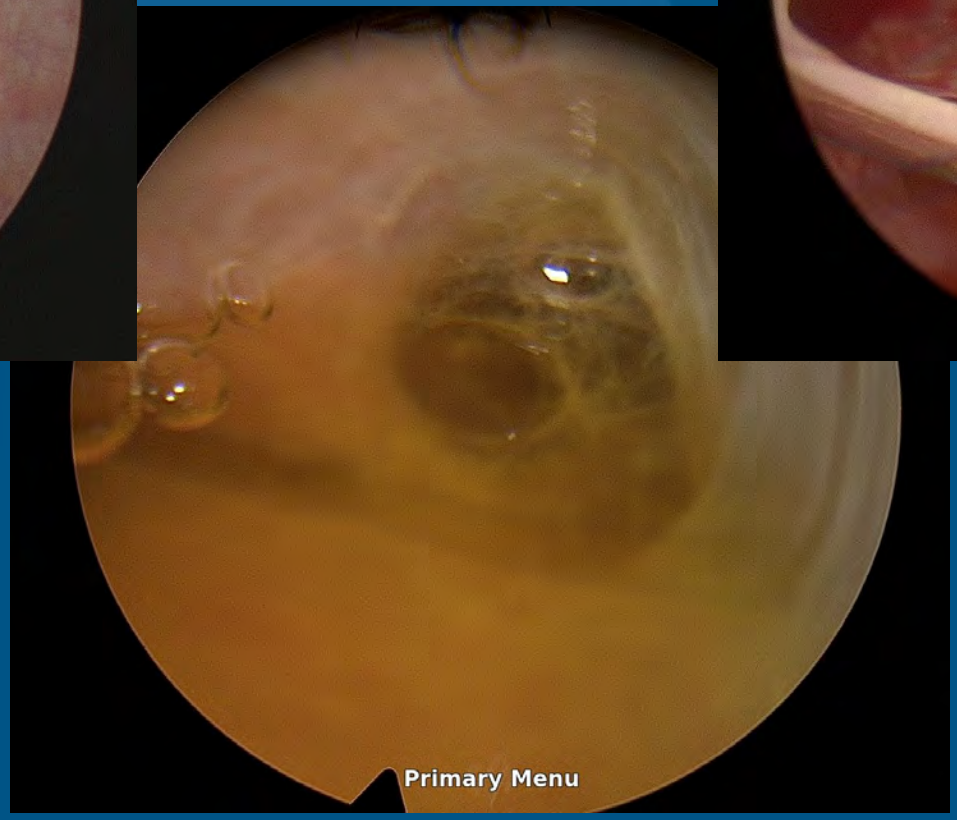
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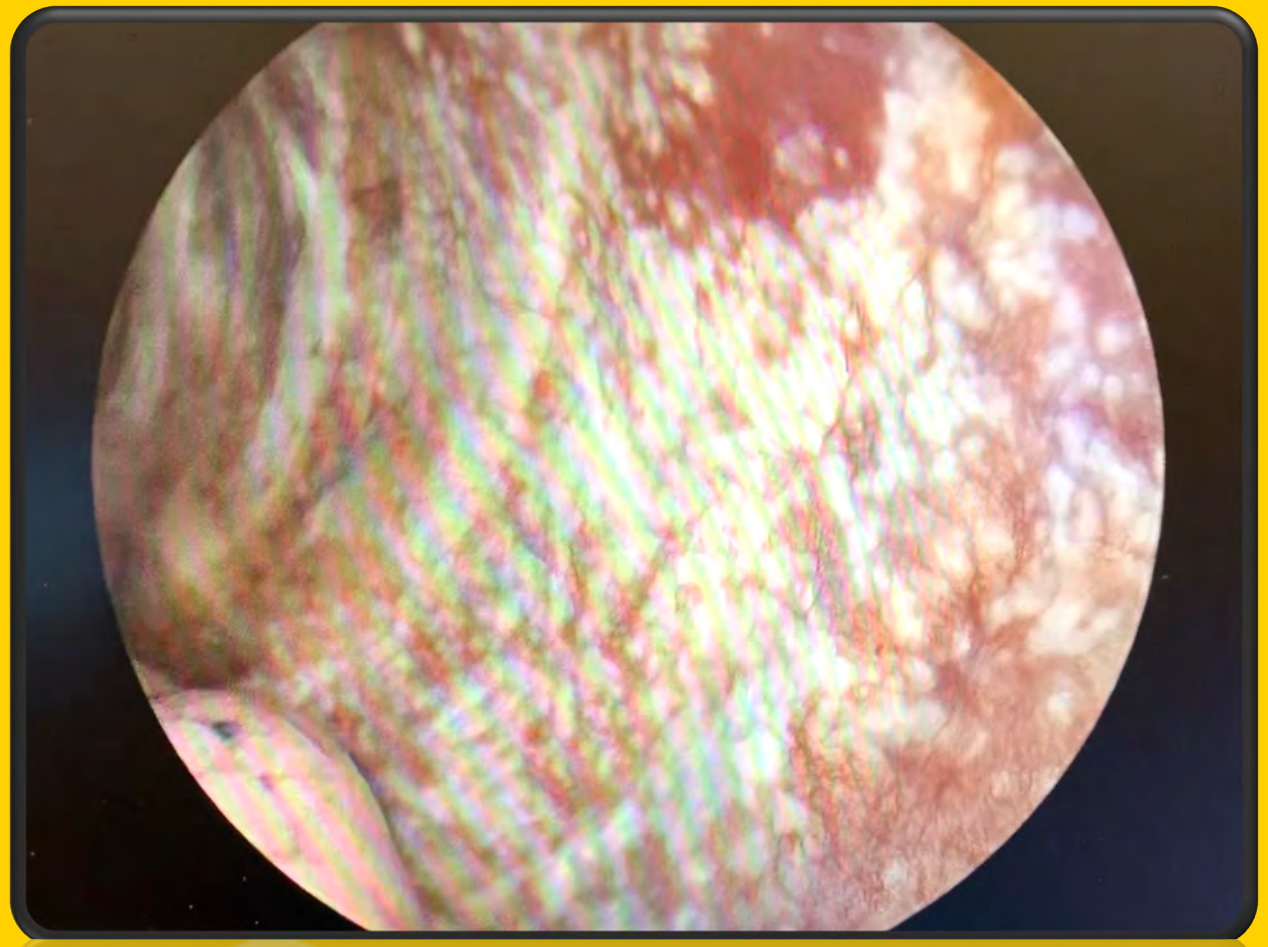
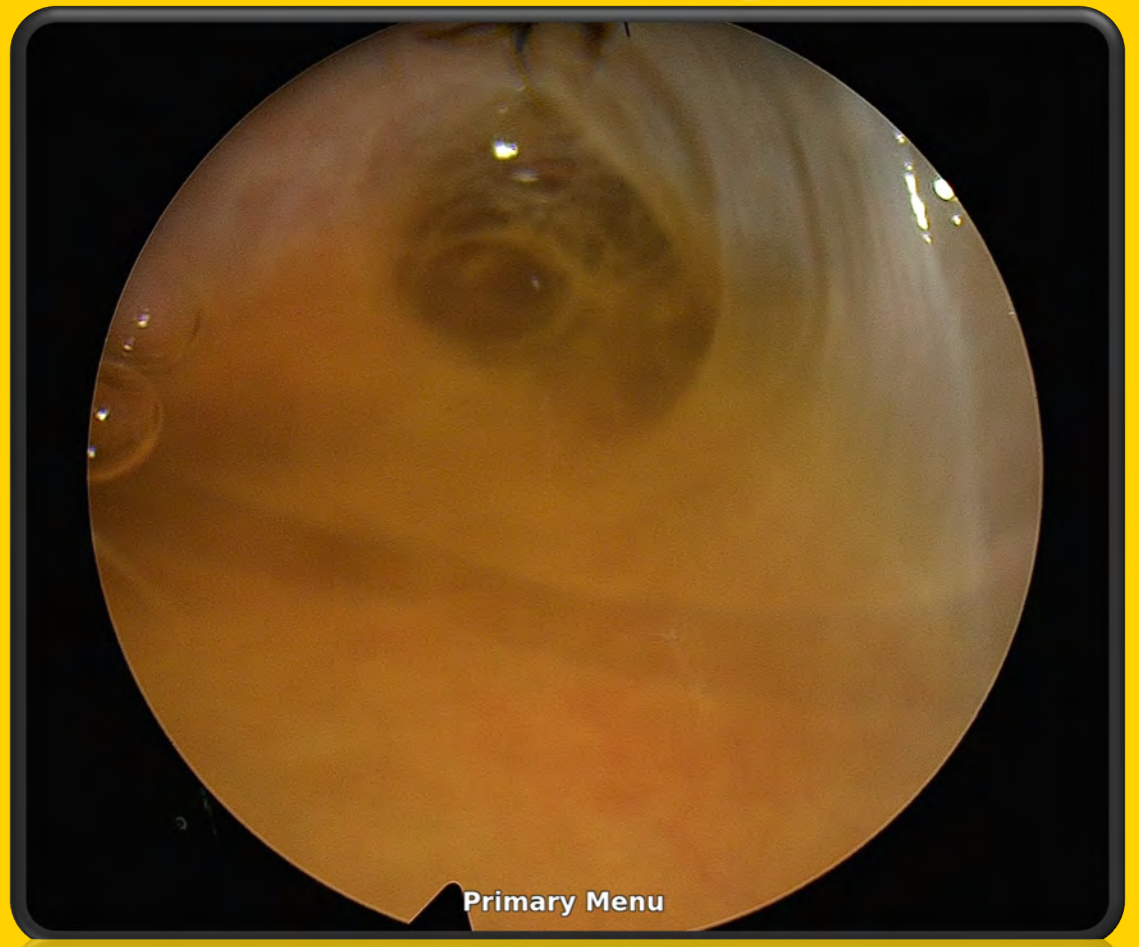




NON-SPECIFIC PLEURITIS

Study	Year	Procedure	NSP	Outcome
Ryan	1981	Thoracotomy	51	Malignant 13 (25.5%)
Ferrer	1981	Thoracoscopy	40	Malignant 2 (5%)
Janssen	1989	Thoracoscopy	208	Malignant 31 (15%)
Venekamp	1991	Thoracoscopy	68	Malignant 5 (8.3%)
Janssen	2004	Thoracoscopy	391	Malignant 31 (4.3%)
DePew	2014	Thoracoscopy	86	Malignant 3 (3.5%)
Karpathiou	2020	VATS/MT	295	Malignant 3 (1.0%)

PSEUDOEXUDATES

- 30% of cardiac effusions are exudates
- Serum – pleural gradients:
  - Albumin gradient > 1.2 g/dL
  - Total protein gradient > 2.5 g/dL

Original Article

Development and validation of a scoring system for the identification of pleural exudates of cardiac origin☆

José M. Porcel[a,*], Lucia Ferreiro[b], Carme Civit[a], Luis Valdés[b], Aureli Esquerda[c], Richard W. Light[d], Silvia Bielsa[a]

- N = 3,182, retrospective
- SPAG or SPPG → corrected 87% of misclassified CHF in derivation cohort
- SPAG or SPPG → 96% of misclassified CHF in validation cohort

The Serum-Effusion Albumin Gradient in the Evaluation of Pleural Effusions*

Bernard J. Roth, M.D.; Thomas F. O'Meara, M.D.; and W. Hal Cragun, M.D., F.C.C.P.

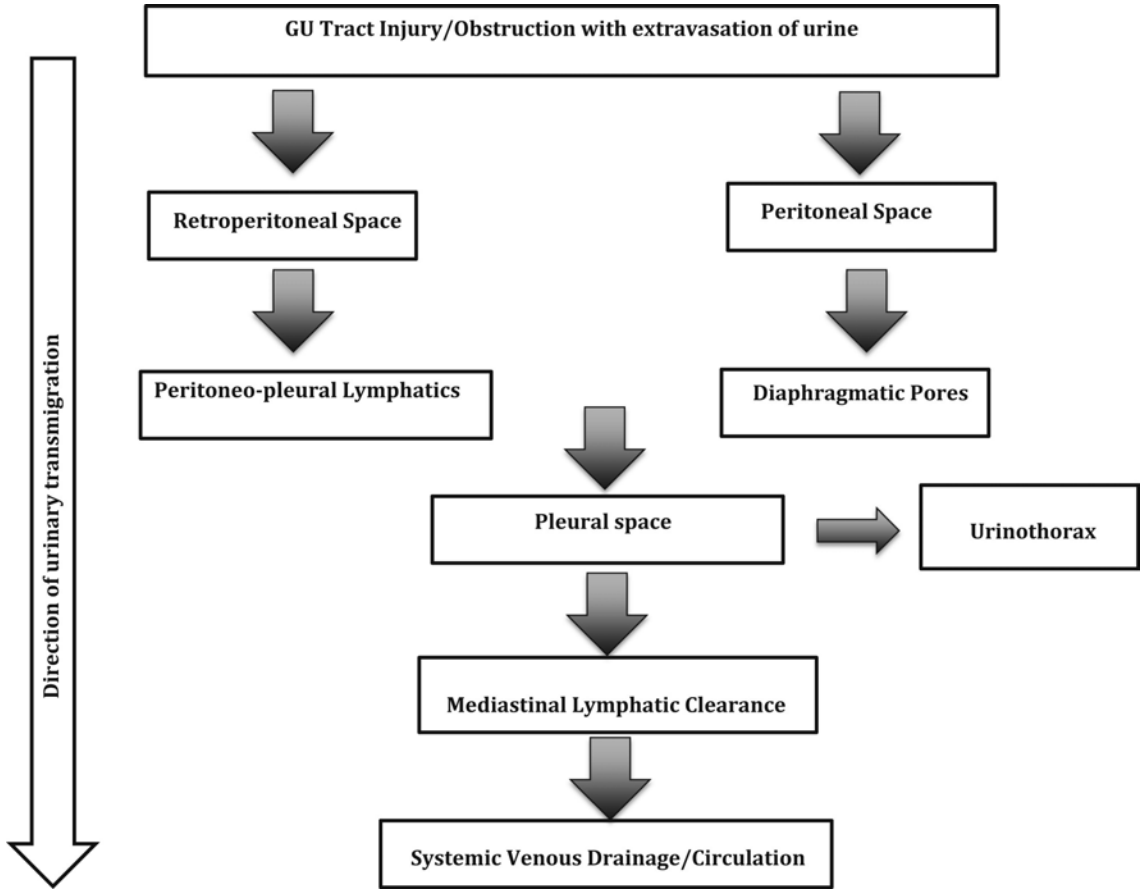
- N = 59, retrospective
- SPAG → corrected all 5 misclassified transudates

Porcel JM, Ferreiro L, Civit C, Valdés L, Esquerda A, Light RW, Bielsa S. Development and validation of a scoring system for the identification of pleural exudates of cardiac origin. European Journal of Internal Medicine. 2018

Roth BJ, O'Meara TF, Cragun WH. The Serum-Effusion Albumin Gradient in the Evaluation of Pleural Effusions. Chest. 1990

URINOTHORAX = PF/S CREATININE > 1.0

- Obstructive uropathy or GU tract injury
- Typically ipsilateral
- Clear
- Protein < 1.0 mg/dL
- Transudate in 31 (48%)
- Exudate in 17 (27%)
- Unclassified in 16 (25%)
- Low pH <7.40
- Paucicellular



Austin A, Jogani SN, Brasher PB, Argula RG, Huggins JT, Chopra A. The Urinothorax: A Comprehensive Review With Case Series. The American Journal of the Medical Sciences. 2017

UCLA Health

SUMMARY

Diagnostic conundrum

History, history, history

Pleural fluid biomarkers

Cytology – provide clinical context

Thoracoscopy

UCLA Health

Advances in Chest Tube Management for Malignant and Non-Malignant Conditions

David Hsia, MD
Professor
Harbor-UC Los Angeles

Dr. David Hsia received his medical degree from the Keck School of Medicine at USC. He did his training in Internal Medicine at St. Mary Medical Center, Pulmonary/ Critical Care fellowship at Harbor-UCLA Medical Center, and Interventional Pulmonology fellowship at National Jewish Health. Currently he is the Director of Bronchoscopy and Interventional Pulmonology Services at Harbor- UCLA Medical Center and also serves as the Chief of the Division of Respiratory and Critical Care Physiology and Medicine.

ADVANCES IN CHEST TUBE MANAGEMENT FOR MALIGNANT AND NON-MALIGNANT CONDITIONS

David Hsia, M.D.

Health Sciences Clinical Professor, DGSOM at UCLA

Director, Bronchoscopy and Interventional Pulmonology Services

Harbor-UCLA Medical Center

California Thoracic Society

RELEVANT FINANCIAL DISCLOSURES

- I have the following relationships with ACCME defined ineligible companies:

- MEDTRONIC - SPEAKER
- VERACYTE - INDUSTRY-SPONSORED STUDY
- NUVAIRA - INDUSTRY-SPONSORED STUDY
- GALVANIZE THERAPEUTICS - INDUSTRY-SPONSORED STUDY
- SANOFI - INDUSTRY-SPONSORED STUDY
- PULMONX - INDUSTRY-SPONSORED STUDY

- I WILL/WILL NOT discuss off-label use and/or investigational use of any drugs or devices.

California Thoracic Society

Overview

- Spontaneous Pneumothorax
- Complicated Pleural Infections
- Post Surgical
- Malignant Pleural Effusion

Roberts, et al. *Thorax*. 2023;78(Suppl 3):s1-s42.

British Thoracic Society Guideline for pleural disease

Mark E Roberts,[1] Najib M Rahman ,[2,3,4] Nick A Maskell,[5] Anna C Bibby,[5] Kevin G Blyth ,[6,7] John P Corcoran ,[8] Anthony Edey,[9] Matthew Evison ,[10] Duneesha de Fonseka ,[11] Rob Hallifax,[12] Susan Harden,[13] Iain Lawrie,[14] Eric Lim,[15] David McCracken,[16] Rachel Mercer,[17] Eleanor K Mishra ,[18] Andrew G Nicholson,[19] Farinaz Noorzad,[20] Kirstie S Opstad,[21] Maria Parsonage,[22] Andrew E Stanton ,[23] Steven Walker[5]

For numbered affiliations see end of article.

Correspondence to
Dr Mark E Roberts, Department of Respiratory Medicine, King's Mill Hospital, Sutton-in-Ashfield, UK; mark.roberts@nhs.net

To cite: Roberts ME, Rahman NM, Maskell NA, *et al*. *Thorax* Epub ahead of print: [*please include* Day Month Year]. doi:10.1136/thorax-2023-220304

INTRODUCTION

The following is a summary of the British Thoracic Society (BTS) Guideline for pleural disease and includes a summary of the guideline recommendations and good practice points (GPPs). The full guideline is published as a separate Thorax Supplement[1] and is available from the BTS website.[2] Please refer to the full guideline for full information about each section.[1] All online supplemental appendices are also available via the BTS website.[2]

BACKGROUND

The aim of the guideline was to provide evidence-based guidance on the investigation and management of pleural disease. Pleural disease is common and represents a major and rapidly developing subspecialty that presents to many different hospital services. Since the last BTS Guideline for pleural disease published in 2010,[3–9] many high quality and practice changing studies, using patient centred outcomes, have been published. The paradigms for the investigation and management of pleural disease have therefore shifted, so this guideline aimed to capture this evidence and use it to answer the most important questions relevant to today's practice.

Target audience for the guideline

The guideline will be of interest to UK based clinicians caring for adults with pleural disease, including chest physicians, respiratory trainees, specialist respiratory nurses, specialist lung cancer nurses, specialist pleural disease nurses, pathologists, thoracic surgeons, thoracic surgeon trainees, acute physicians, oncologists, emergency physicians, hospital practitioners, intensive care physicians, palliative care physicians, radiologists, other allied health professional and patients and carers.

Areas covered by the guideline

The guideline focuses on the investigation and management of pleural disease in adults and covers four broad areas of pleural disease:

a. Spontaneous pneumothorax
b. Undiagnosed unilateral pleural effusion
c. Pleural infection
d. Pleural malignancy

Adult patients in both inpatient and ambulatory settings are considered.

The guideline does not cover mesothelioma (as alternative guidance is available[10]), benign (non-infectious, non-pneumothorax) pleural disease or rare pleural diseases. Guidance on pleural interventions is also covered in the BTS Clinical Statement on Pleural Procedures.[11]

Methodology

BTS guidelines use the GRADE (Grading of Recommendations, Assessment, Development and Evaluations) methodology for guideline development.[12] GRADE is a systematic and transparent process for assessing the quality of the evidence and the full GRADE process involves:

i. Systematic review,
ii. Critical appraisal; and
iii. GRADE analysis.

Full details of the BTS process are available in the BTS Guideline production manual (https://www.brit-thoracic.org.uk/quality-improvement/guidelines/).

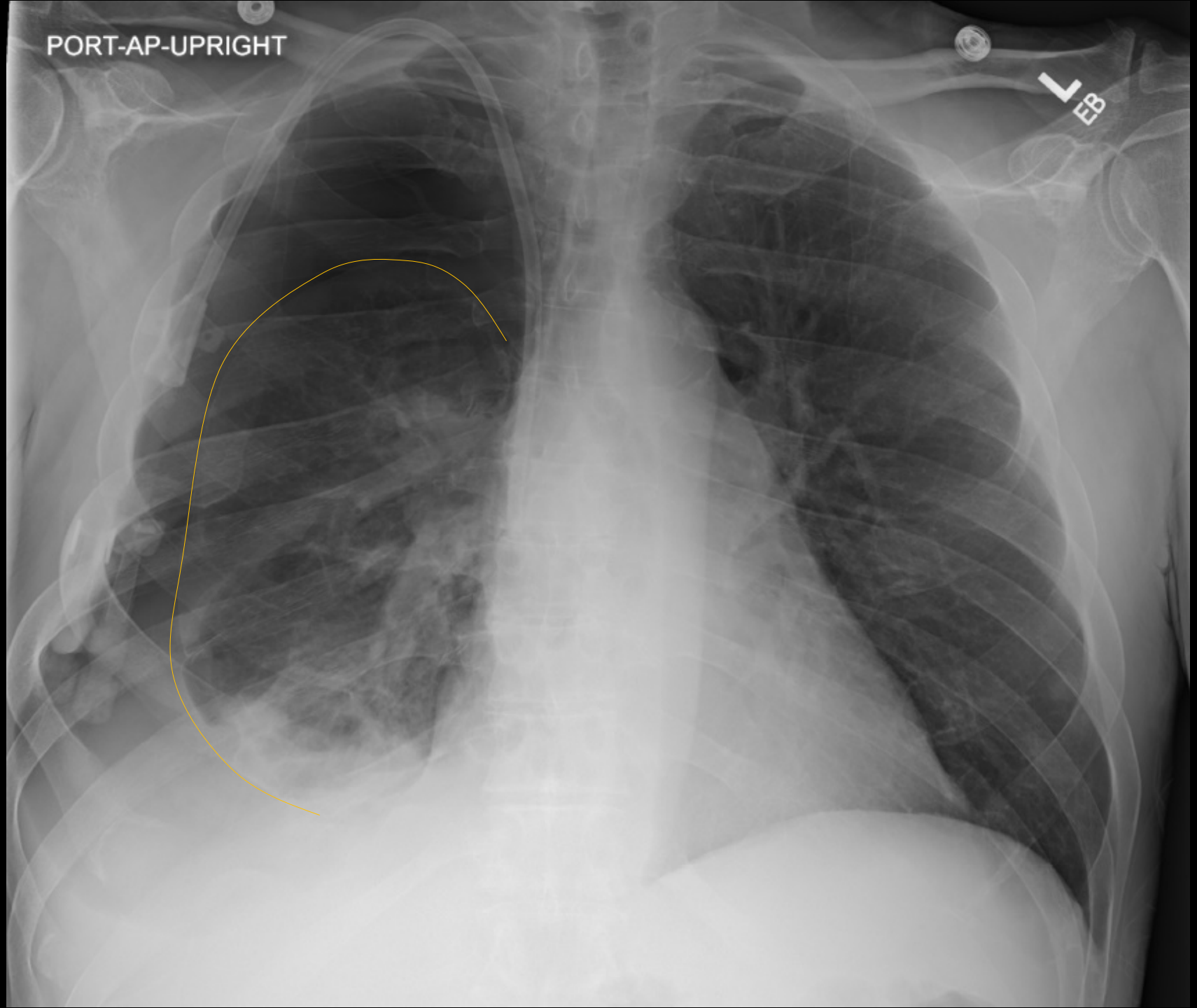
Clinical questions, patient-centred outcomes and literature search

Clinical questions were defined from the scope of the guideline formulated into PICO (population, intervention, comparator, and outcome) style framework diagnostic accuracy, intervention or prognostic review formats. Patient-centred outcomes were agreed by the group for each question.

The PICO framework formed the basis of the literature search. The initial searches were completed by the University of York, and the latter stages by BTS Head Office. Systematic electronic database searches were conducted to identify all papers that may be relevant to the guideline. For each question, the following databases were searched: Cochrane Database of Systematic Reviews (CDSR), Cochrane Central Register of Controlled Trials (CENTRAL), MEDLINE and EMBASE. The search strategy is available for review in Online Appendix 1 (accessible via the full guideline).

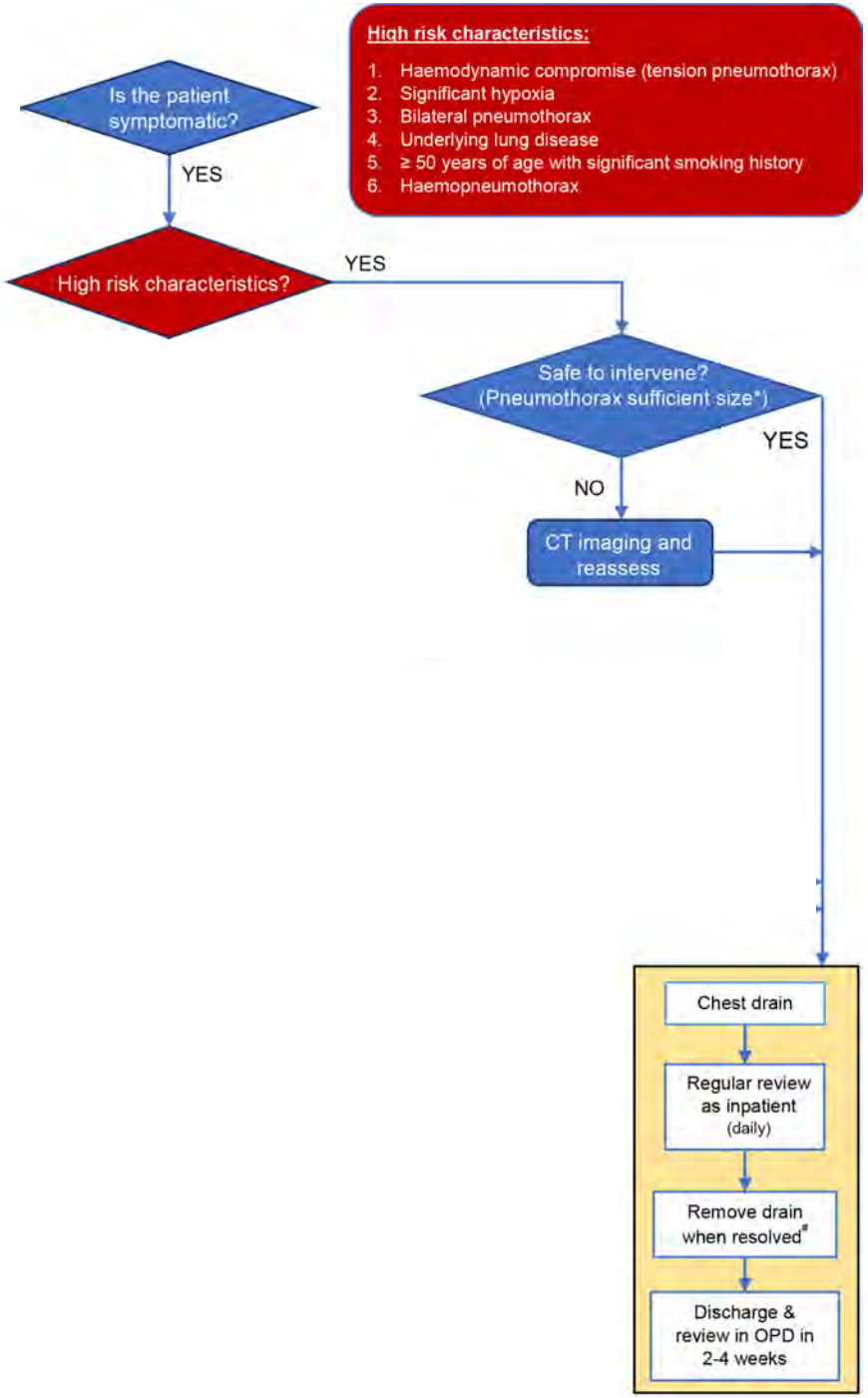
Critical appraisal and GRADE analysis of the evidence

After an initial screening to determine relevance to the clinical questions, each paper was assessed to determine if it addressed:


PORT-AP-UPRIGHT
EB

Chest Tube Basics for PTX

- Poiseuille's Law: $R = \frac{8\eta l}{\pi r^4}$
- Small bore preferred over large bore
- Minimize suction / use water seal
- After 4-5 days, consider alternative strategies
  - Autologous blood patch
  - Endobronchial valve
  - Surgical consultation



Roberts, et al. *Thorax*. 2023;78(Suppl 3):s1-s42.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Digital vs. Analog?

- Systematic review, 23 articles
  - 19 post-operative BPF
  - 4 spontaneous PTX

- **Post-op BPF:** most studies show no significant difference in chest tube duration and hospital LOS

- **Spontaneous PTX:** limited data, possible reduction in chest tube duration and hospital LOS

[Thoracic Oncology Original Research]

CHEST

A Systematic Review of Digital vs Analog Drainage for Air Leak After Surgical Resection or Spontaneous Pneumothorax

Fadi Aldaghlawi, MD; Jonathan S. Kurman, MD; Jason A. Lilly, MLS; D. Kyle Hogarth, MD; Jessica Donington, MD; Mark K. Ferguson, MD; and Septimiu D. Murgu, MD

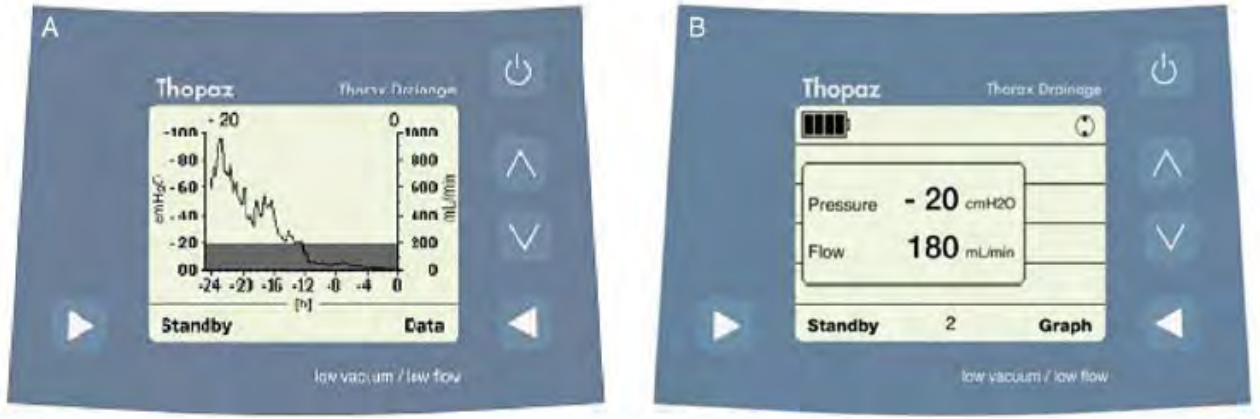


Figure 2: (**A**) The digital system in graph mode displays the air leak volume over time (ml/min; thin line) and intrapleural pressure (cmH_2O; grey bars). (**B**) The digital system in data mode displays the pressure applied to the pleural space and current air leak flow. This model records 40 patient-days of data. (Image printed with permission from: Thopaz, Medela, Baar, Switzerland)

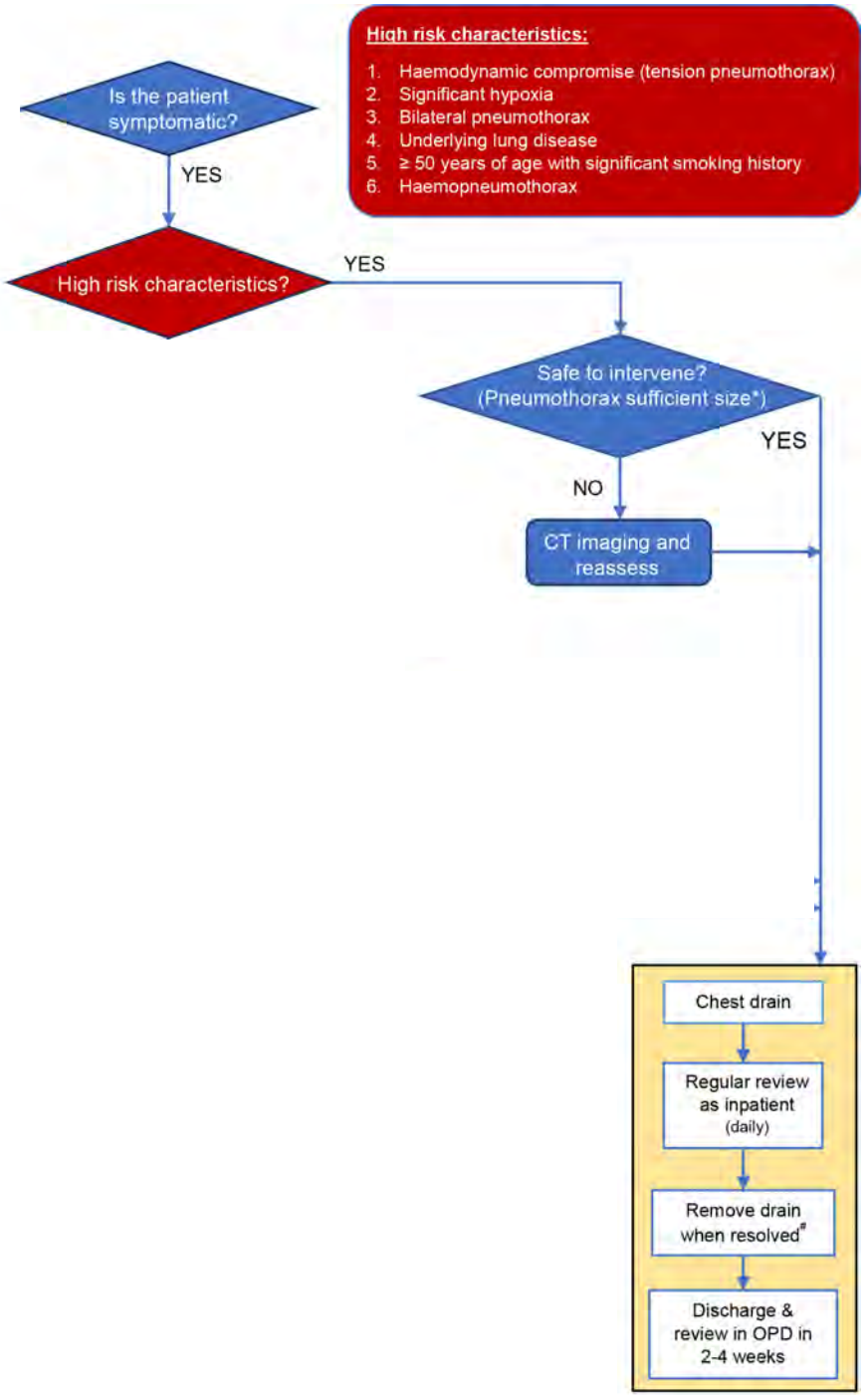
Aldaghlawi, et al. *Chest* 2020;157(5):1346-1353.
Ruigrok, et al. *BMC Pulm* 2020(20):136.
McGuire, et al. *Interact Cardiovasc Thorac Surg.* 2015;21(4):403-7.

Are Chest Tubes Always Necessary?

Guideline summary

British Thoracic Society Guideline for pleural disease

Mark E Roberts,[1] Najib M Rahman ,[2,3,4] Nick A Maskell,[5] Anna C Bibby,[5] Kevin G Blyth ,[6,7] John P Corcoran ,[8] Anthony Edey,[9] Matthew Evison ,[10] Duneesha de Fonseka ,[11] Rob Hallifax,[12] Susan Harden,[13] Iain Lawrie,[14] Eric Lim,[15] David McCracken,[16] Rachel Mercer,[17] Eleanor K Mishra ,[18] Andrew G Nicholson,[19] Farinaz Noorzad,[20] Kirstie S Opstad,[21] Maria Parsonage,[22] Andrew E Stanton ,[23] Steven Walker[5]



Roberts, et al. *Thorax*. 2023;78(Suppl 3):s1-s42.

The NEW ENGLAND JOURNAL of MEDICINE

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Conservative versus Interventional Treatment for Spontaneous Pneumothorax

S.G.A. Brown, E.L. Ball, K. Perrin, S.E. Asha, I. Braithwaite, D. Egerton-Warburton, P.G. Jones, G. Keijzers, F.B. Kinnear, B.C.H. Kwan, K.V. Lam, Y.C.G. Lee, M. Nowitz, C.A. Read, G. Simpson, J.A. Smith, Q.A. Summers, M. Weatherall, and R. Beasley, for the PSP Investigators*

- Open-label, multicenter, noninferiority RCT
- 316 patients
  - 152 interventional management
  - 162 conservative mana
- Inclusion:
  - Age 14-50 years
  - Unilateral primary spo
  - > 32% PTX on CXR (Collins method)

Primary outcome - complete radiographic resolution after 8 weeks

- Interventional group: 98.5%
- Conservative group: 94.4%

- Interventional
  - Small bore tube, water seal
  - Removal in 1 hr if no air leak and CXR lung reexpansion
  - Discharge after 4 hrs if stable on CXR vs. admit if recurrence
- Conservative
  - Discharge if stable PTX after > 4 hrs on CXR
  - Intervention performed:
    - willing to continue with ve management
    - symptoms
    - amic compromise
    - 90
    - SBP
    - RR > 30
    - SpO_2 <90% on RA

Brown, et al. *New Engl J Med* 2020;382:405-15.

Table 2. Secondary Outcomes.*

Outcome	Interventional Management (N=154)	Conservative Management (N=162)	Relative Risk (95% CI)	Risk Difference (95% CI)†
One or more procedures — no. (%)	145 (94.2)	25 (15.4)	6.10 (4.24–8.77)	78.1 (72.0–85.4)
Chest drainage for ≥72 hr — no./total no. (%)	78/153 (51.0)	15/162 (9.3)	5.51 (3.32–9.14)	41.7 (32.6–50.8)
Suction — no. (%)	52 (33.8)	12 (7.4)	4.56 (2.53–8.20)	26.4 (17.9–34.9)
At least one CT scan — no./total no. (%)	28/146 (19.2)	12/154 (7.8)	2.46 (1.31–4.66)	11.4 (3.7–19.1)
Hospital revisit — no. (%)	41 (26.6)	28 (17.3)	1.54 (1.01–2.36)	9.3 (0.3–18.4)
Any adverse event — no. (%)	41 (26.6)	13 (8.0)	3.32 (1.85–5.95)	18.6 (10.5–26.7)
Any serious adverse event — no. (%)	19 (12.3)	6 (3.7)	3.30 (1.37–8.10)	8.6 (2.7–14.6)
Pneumothorax recurrence within 12 mo — no./total no. (%)	25/149 (16.8)	14/159 (8.8)	1.90 (1.03–3.52)	8.0 (0.5–15.4)
No. of chest radiographs per patient	10.9±7.1	6.4±3.9	1.7 (1.6–1.8)‡	4.5 (3.2–5.8)§
No. of surgical procedures per patient¶	0.3±0.5	0.1±0.2	4.21 (2.10–8.41)‡	
Length of hospital stay in first 8 wk — days				
Mean	6.1±7.6	1.6±3.5	2.8 (1.8–3.6)‖	
Median (IQR)	3.8 (0.8–9.3)	0.2 (0.2–0.8)		
Days off from work				
Mean	10.9±12.7	6.0±7.3	2.0 (1.0–3.0)‖	
Median (IQR)	6.0 (2.0–14.0)	3.0 (1.0–8.0)		

Brown, et al. *New Engl J Med* 2020;382:405-15.

ORIGINAL ARTICLE

Simple Aspiration versus Drainage for Complete Pneumothorax

A Randomized Noninferiority Trial

Tania Marx[1], Luc-Marie Joly[4], Anne-Laure Parmentier[2], Jean-Baptiste Pretalli[3], Marc Puyraveau[2], Jean-Claude Meurice[5], Jeannot Schmidt[6], Olivier Tiffet[7], Gilbert Ferretti[9], Dominique Lauque[10], Didier Honnart[11], Faraj Al Freijat[12], Alain Eric Dubart[13], Romain Genre Grandpierre[14], Alain Viallon[8], Dominique Perdu[15], Pierre Marie Roy[16], Toufiq El Cadi[17], Nathalie Bronet[18], Grégory Duncan[19], Gilles Cardot[20], Philippe Lestavel[21], Frédéric Mauny[2], and Thibaut Desmettre[1]

- Prospective, open-label, multicenter, noninferiority RCT
- 402 patients
  - 200 simple aspiration
  - 202 chest tube drainage
- Inclusion:
  - Age 18-50 years
  - Symptomatic < 48 hours
  - Primary PTX
  - Complete CXR separation of pleura from apex to base

- Primary outcome - expansion 24 hours post procedure
- Treatment failure after 7 days:
  - 16% simple aspiration
  - 15% chest tube
- Less pain and better tolerated with aspiration
- PTX recurrence 20% vs. 27% (aspiration versus chest tube)

Marx, et al. *Am J Resp Crit Care Med* 2023;207(11):1475-1485.

Ambulatory management of primary spontaneous pneumothorax: an open-label, randomised controlled trial

Rob J Hallifax, Edward McKeown, Parthipan Sivakumar, Ian Fairbairn, Christy Peter, Andrew Leitch, Matthew Knight, Andrew Stanton, Asim Ijaz, Stefan Marciniak, James Cameron, Amrithraj Bhatta, Kevin G Blyth, Raja Reddy, Marie-Clare Harris, Nadeem Maddekar, Steven Walker, Alex West, Magda Laskawiec-Szkonter, John P Corcoran, Stephen Gerry, Corran Roberts, John E Harvey, Nick Maskell, Robert F Miller, Najib M Rahman

- **RAMPP**: **R**andomised **A**mbulatory **M**anagement of **P**rimary **P**neumothorax
- Open-label, randomized, controlled trial
- 236 patients
  - 117 ambulatory care
  - 119 standard care
- Inclusion: Significant symptoms and/or PTX ≥ 2 cm interpleural distance at level of hilum
- Exclusion: Known/suspected underlying lung disease, > 20 pack year smoking history, tension PTX, pregnant/lactating, contraindication to thoracic intervention

Hallifax, et al. *Lancet* 2020;396:39-49.

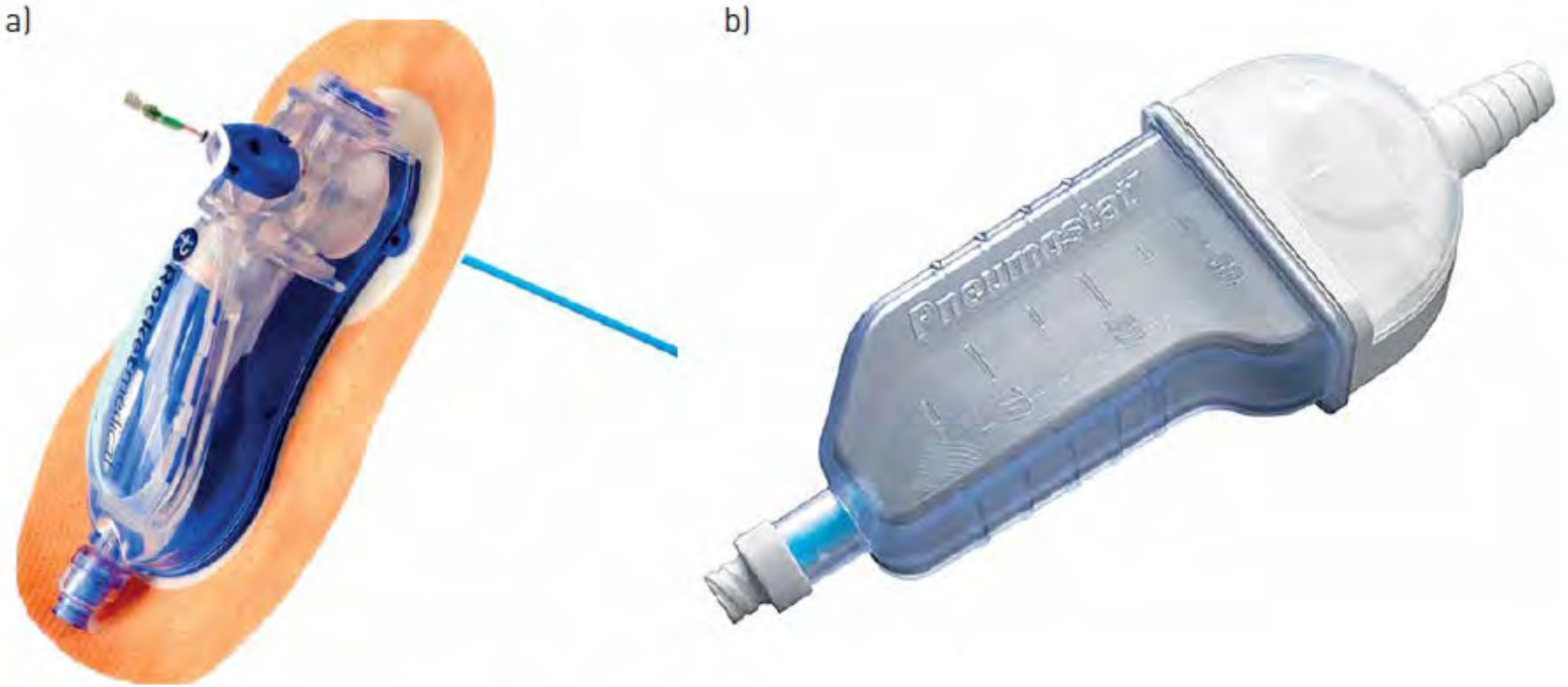
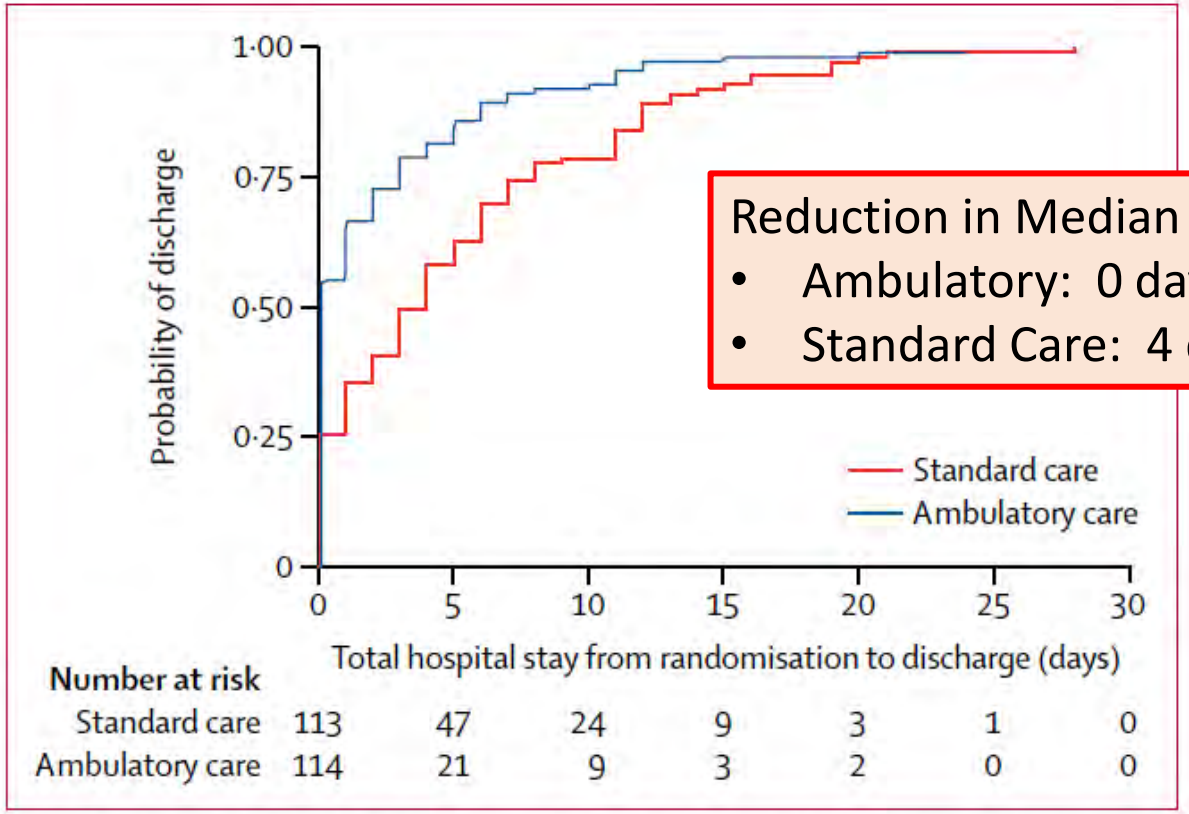


FIGURE 1 a) Pleural Vent. b) Atrium Pneumostat.

Walker, et al. *Eur Respir J* 2021;57:2003375.

Reduction in Hospital Days



Reduction in Median LOS (p<0.0001)

- Ambulatory: 0 days [IQR 0-3]
- Standard Care: 4 days [IQR 0-8]

Figure 2: **Cumulative incidence curve showing time to discharge from randomisation plus re-admissions within 30 days**

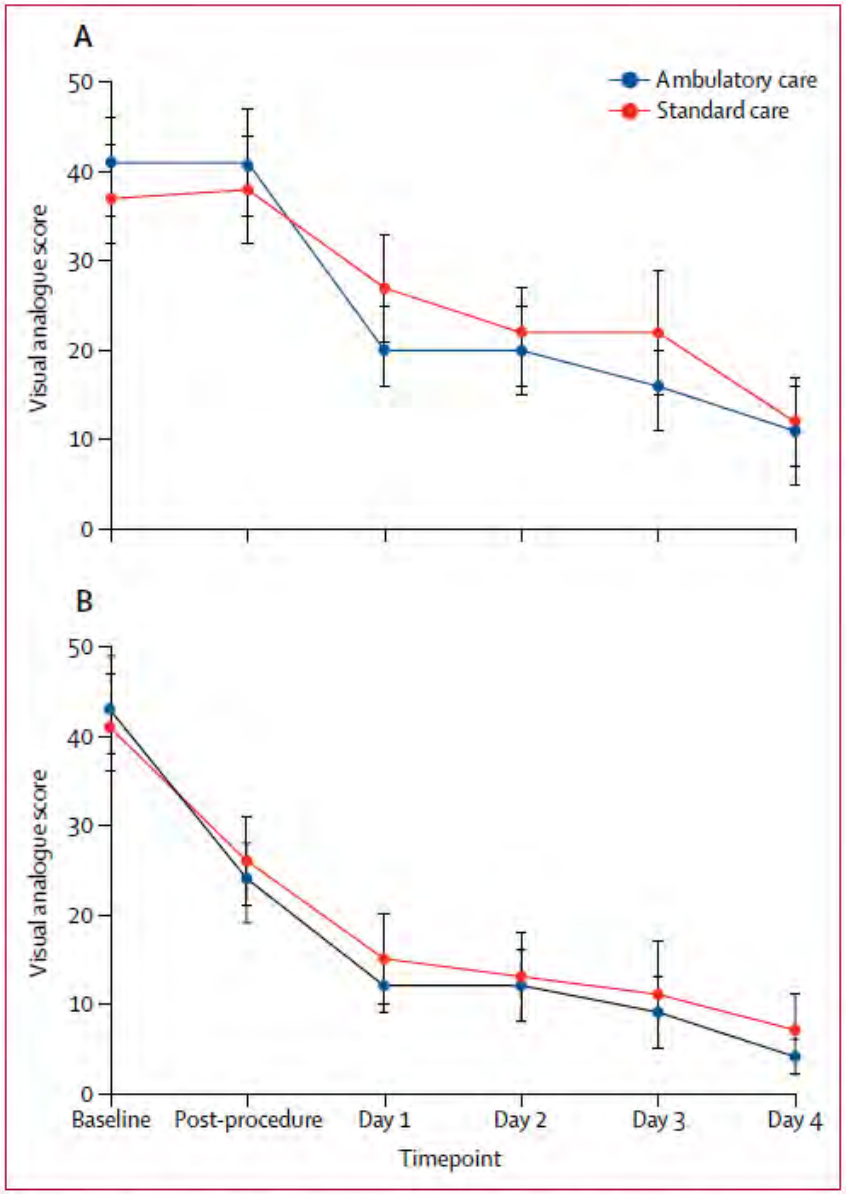


Figure 3: **Visual Analogue Score of pain (A) and breathlessness (B)**
Scores shown for baseline (at enrolment), after the initial procedure, and then daily on days 1–4. Bars represent confidence intervals.

Hallifax, et al. *Lancet* 2020;396:39-49.

Additional Interventions and Adverse Events

- Fewer additional interventions
  - 21% ambulatory care (24)
  - 35% standard care (42)

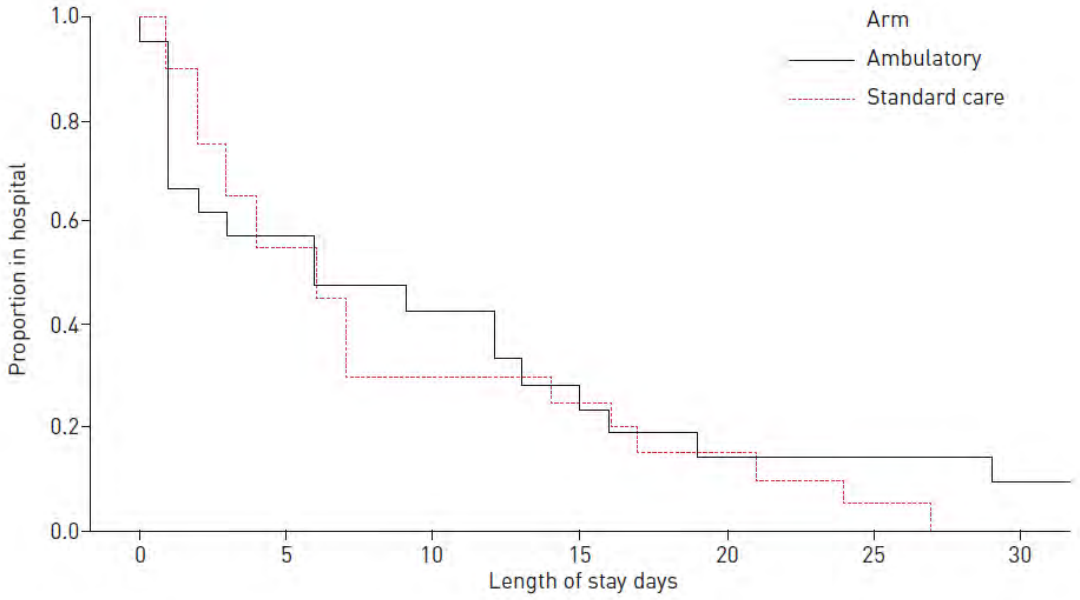
- 12% SAEs – all in the ambulatory care arm (14)
  - 3% enlarging PTX (4)
  - 2% device blocked/kinked (2)
  - 1% device dislodgement (1)
  - 1% re-expansion pulmonary edema (1)
  - 1% admitted for suction (1)

	Patients receiving ambulatory care (n=117)	Patients receiving standard care (n=119)	p value
Any serious adverse event or adverse event	64 (55%)	46 (39%)	0·0135
Serious adverse events	14 (12%)	0	<0·0001
Serious adverse events related to treatment*			
Enlarging pneumothorax†	4 (3%)	0	..
Device blocked or kinked†	2 (2%)	0	..
Device dislodgement†	1 (1%)	0	..
Re-expansion pulmonary oedema (asymptomatic)	1 (1%)	0	..
Device leakage†	1 (1%)	0	..
Admitted for suction	1 (1%)	0	..
Serious adverse events unrelated to treatment*			
Unrecognised haemopneumothorax†	3 (3%)	0	..
Pleurisy	1 (1%)	0	..
Adverse events related to treatment*	51 (44%)	40 (34%)	0·1154
Pain at tube site	36 (31%)	36 (30%)	..
Haematoma or bleeding	8 (7%)	2 (2%)	..
Subcutaneous emphysema	7 (6%)	7 (6%)	..
Site infection	1 (1%)	1 (1%)	..
Tube displacement	2 (2%)	1 (1%)	..
Drainage device failure	3 (3%)	1 (1%)	..
Blocked tube	1 (1%)	1 (1%)	..
Fluid within tube	3 (3%)	0	..
Other chest pain	2 (2%)	4 (3%)	..
Erythema or itch	2 (2%)	0	..
Attendance at emergency department	1 (1%)	0	..

Hallifax, et al. *Lancet* 2020;396:39-49.

Ambulatory management of secondary spontaneous pneumothorax: a randomised controlled trial

Steven P. Walker[1], Emma Keenan[1], Oliver Bintcliffe[1], Andrew E. Stanton[2], Mark Roberts[3], Justin Pepperell[4], Ian Fairbairn[5], Edward McKeown[6], James Goldring[7], Nadeem Maddekar[8], James Walters[9], Alex West[10], Amrithraj Bhatta[11], Matthew Knight[12], Rachel Mercer[13], Rob Hallifax[13], Paul White[14], Robert F. Miller[15], Najib M. Rahman[13] and Nick A. Maskell[1]



At risk	Day						
	1	5	10	15	20	25	30
Ambulatory care	20	13	9	5	3	3	1
Standard care	19	11	6	5	3	1	0

FIGURE 3 Cumulative incidence curve demonstrating length of hospital stay within first 30 days.

- Symptomatic secondary spontaneous PTX
- 41 patients with
  - 21 ambulatory care
  - 20 standard care
- No difference in LOS
- 46% early treatment failure with pleural vent vs. 15% with standard care. 0% with atrium pneumostat device.
- Pleural vent stopped early due to safety

Walker, et al. *Eur Respir J* 2021;57:2003375.

Summary on Conservative Approaches to PTX

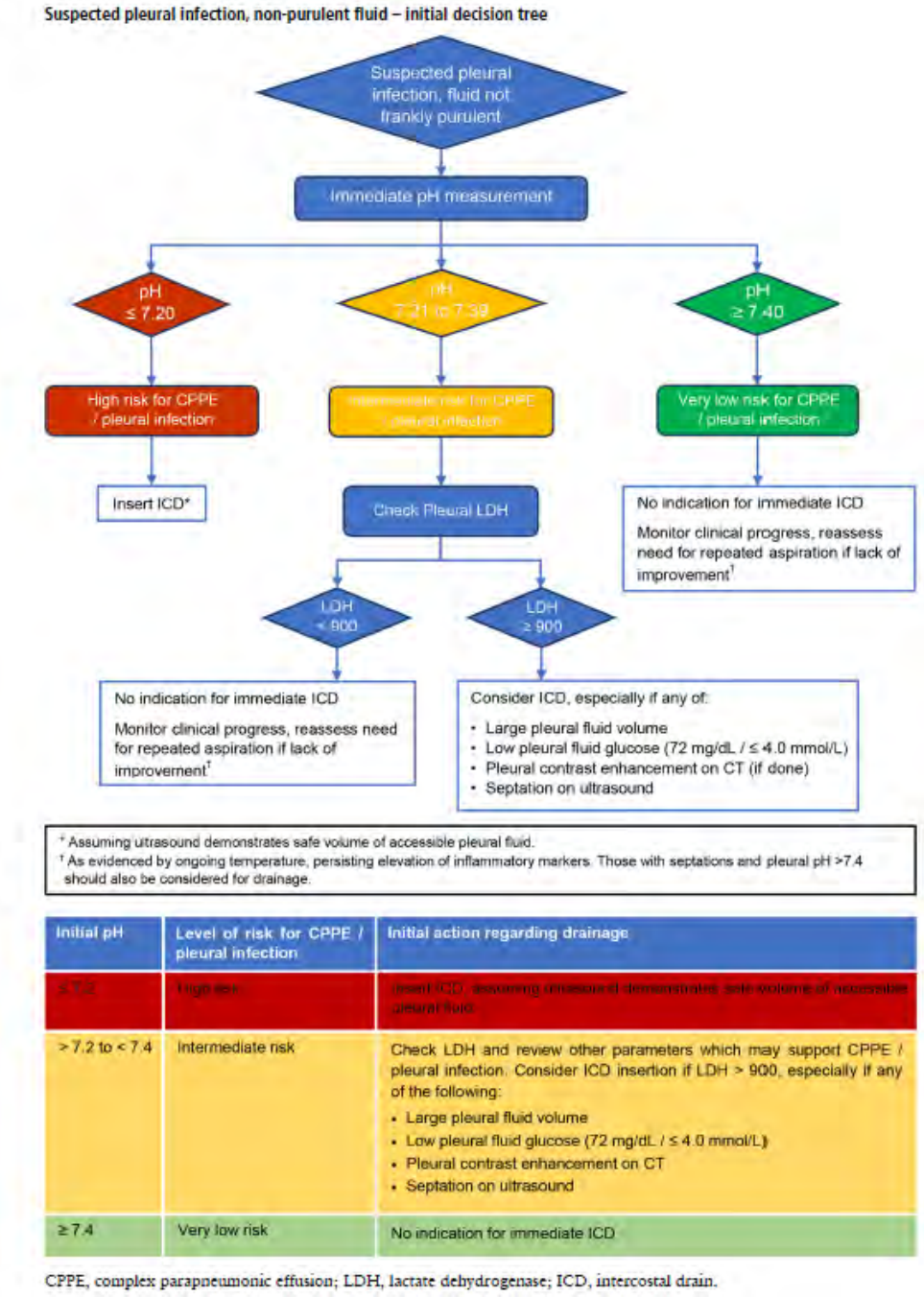
- BTS Guidelines:
  - “Conditional” level of recommendation
  - “Consider” … “adults with good support and in centres with available expertise and follow-up facilities”

- Benefit in select populations:
  - Primary Spontaneous PTX >> Secondary Spontaneous PTX
  - Trials targeted younger asymptomatic patients without lung disease

- Even if a risk-adverse approach is taken, can we adapt current practices to selectively incorporate more conservative strategies?

Chest Tube Basics for Parapneumonic Infections

- Pleural pH threshold of 7.20 is a common threshold to necessitate chest tube insertion
- Small bore preferred over large bore
- 33.5% fail chest tube + abx therapy
  - Multi-center observational study (PILOT)



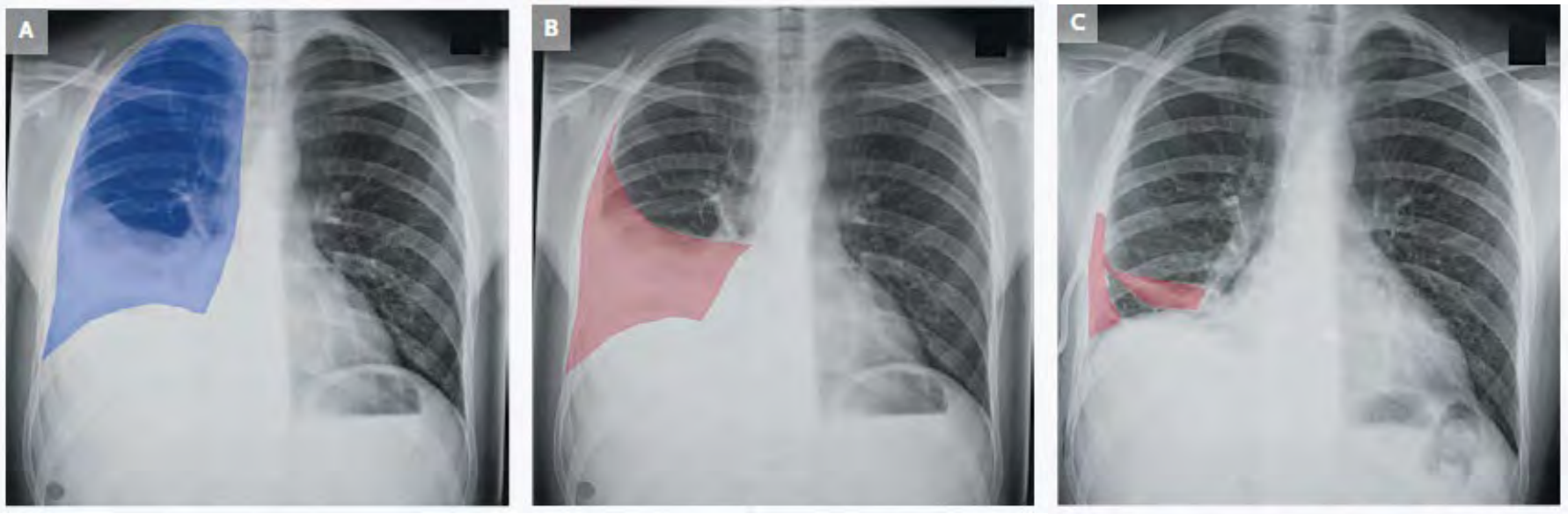
Initial pH	Level of risk for CPPE / pleural infection	Initial action regarding drainage
≤ 7.2	High risk	Insert ICD, assuming ultrasound demonstrates safe volume of accessible pleural fluid
> 7.2 to < 7.4	Intermediate risk	Check LDH and review other parameters which may support CPPE / pleural infection. Consider ICD insertion if LDH > 900, especially if any of the following: • Large pleural fluid volume • Low pleural fluid glucose (72 mg/dL / ≤ 4.0 mmol/L) • Pleural contrast enhancement on CT • Septation on ultrasound
≥ 7.4	Very low risk	No indication for immediate ICD

CPPE, complex parapneumonic effusion; LDH, lactate dehydrogenase; ICD, intercostal drain.

Roberts, et al. *Thorax*. 2023;78(Suppl 3):s1-s42.
Corcoran, et al. *Eur Respir J.* 2020;56(5):2000130.

MIST2: Intrapleural tPA + DNAse

- Intrapleural tPA 10 mg and DNAse 5 mg BID x3 days
- Sequential administration with 1 hour clamp time
- Primary Outcome: CXR improvement



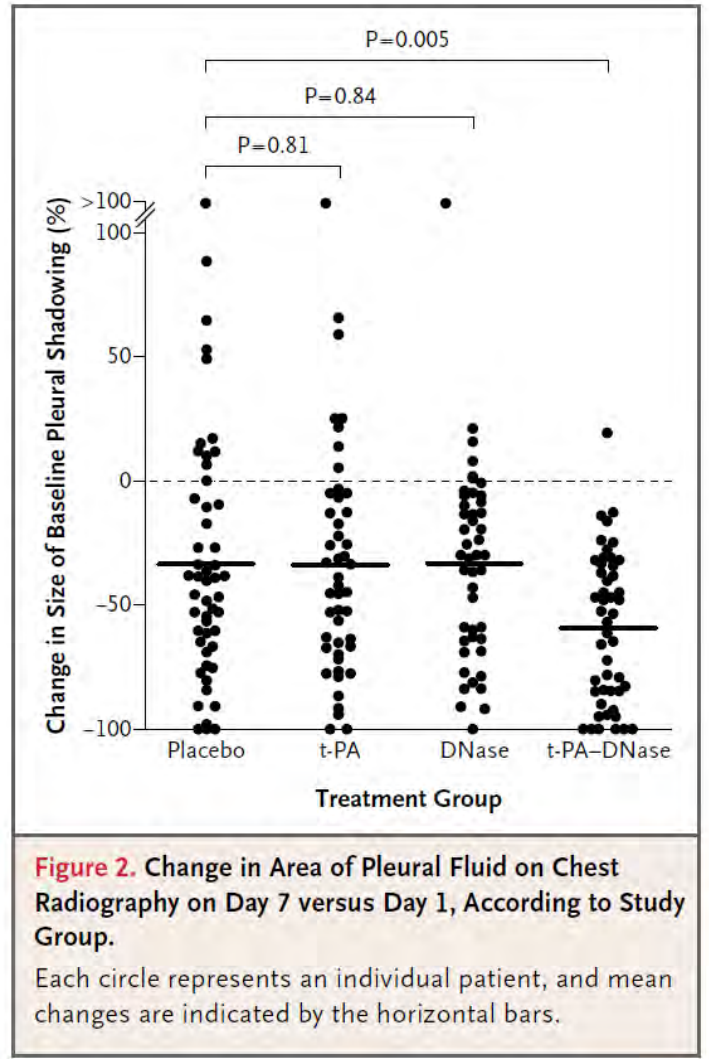


Figure 2. Change in Area of Pleural Fluid on Chest Radiography on Day 7 versus Day 1, According to Study Group.

Each circle represents an individual patient, and mean changes are indicated by the horizontal bars.

Rahman, et al. *N Engl J Med* 2011;365:518-26.

[Thoracic Oncology Original Research]

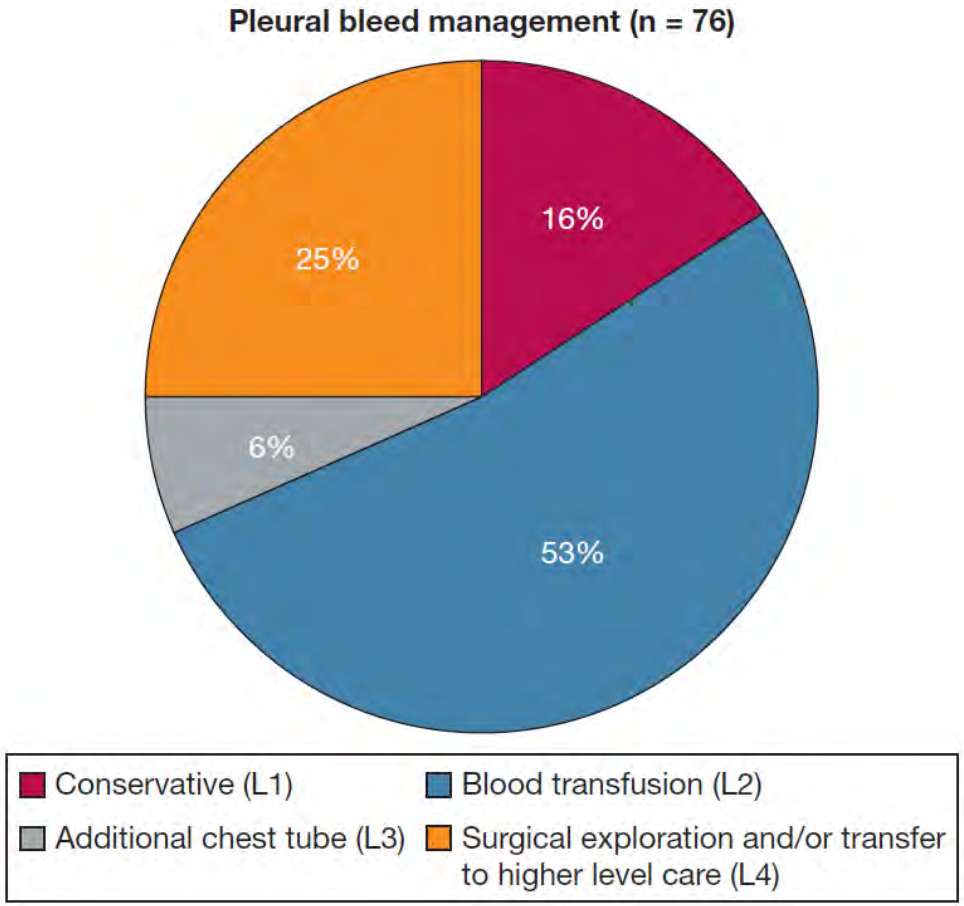
CHEST

Bleeding Risk With Combination Intrapleural Fibrinolytic and Enzyme Therapy in Pleural Infection

An International, Multicenter, Retrospective Cohort Study

Jason Akulian, MD; Eihab O. Bedawi, MBBS; Hawazin Abbas, MD; Christine Argento, MD; David T. Arnold, PhD; Akshu Balwan, MD; Hitesh Batra, MD; Juan Pablo Uribe Becerra, MD; Adam Belanger, MD; Kristin Berger, MD; Allen Cole Burks, MD; Jiwoon Chang, MD; Ara A. Chrissian, MD; David M. DiBardino, MD; Xavier Fonseca Fuentes, MD; Yaron B. Gesthalter, MD; Christopher R. Gilbert, DO; Kristen Glisinski, MD; Mark Godfrey, MD; Jed A. Gorden, MD; Horiana Grosu, MD; Mridul Gupta, MD; Fayez Kheir, MD; Kevin C. Ma, MD; Adnan Majid, MD; Fabien Maldonado, MD; Nick A. Maskell, DM; Hiren Mehta, MD; Joshua Mercer, MBBS; John Mullon, MD; Darlene Nelson, MD; Elaine Nguyen, MD; Edward M. Pickering, MD; Jonathan Puchalski, MD; Chakravarthy Reddy, MD; Alberto E. Revelo, MD; Lance Roller, MSc; Ashutosh Sachdeva, MBBS; Trinidad Sanchez, MD; Priya Sathyanarayan, BS; Roy Semaan, MD; Michal Senitko, MD; Samira Shojaee, MD; Ryan Story, MD; Jeffrey Thiboutot, MD; Momen Wahidi, MD; Candice L. Wilshire, MD; Diana Yu, MD; Aline Zouk, MD; Najib M. Rahman, DPhil; and Lonny Yarmus, DO; on behalf of the Interventional Pulmonary Outcomes Group

- Multicenter, retrospective observational study
- 1,851 patients receiving tPA + DNAse
- **4.1%** pleural hemorrhage complication
- Increased bleeding associated with systemic anticoagulation therapy



Akulian, et al. *Chest* 2022;162(6):1384-1392.

Deviating from MIST2

- Concurrent administration of tPA + DNAse
- Effective treatment with less than 6 doses
- Reduction of tPA dose (5 vs. 2.5 mg) if higher bleeding risk
- Saline irrigation (250 mL TID x3 days) can be considered if fibrinolytics are contraindicated

Majid, et al. *Ann Am Thorac Soc.* 2016;13(9):1512-8.
Kheir, et al. *J Bronchology Interv Pulmonol.* 2018;25(2):125-131.
Goh, et al. *Pulm Med.* 2023;Dec 18:6340851.
Popowicz, et al. *Ann Am Thorac Soc.* 2017;14(6):929-936.
Popowicz, et al. *Respirology.* 2022;27(7):510-516.
Hooper, et al. *Eur Respir J.* 2015;46(2):456-63.

MIST3: Intrapleural tPA + DNAse vs. Early VATS

- Open label, multicenter feasibility trial
- 60 complicated pleural infection patients randomized 1:1:1

Intervention	n	Median Time to Intervention	LOS
Standard of Care	21	N/A	10 d
tPA/DNAse	19	1.0 d (IQR 0-1)	7 d (IQR 5.5-10)
Early VATS	20	3.5 d (IQR 1.2-4.0)	7 d (IQR 5.5-10.5)

Bedawi, et al. *Am J Respir Crit Care Med.* 2023;208(12):1305-1315.
Wilshire, et al. *JAMA Netw Open* 2023;6:e237799.

Thank you!

dhsia@lundquist.org

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Pleuroscopy at the Bedside

Pravachan Hegde, MD
Assistant Professor
UC San Francisco-Fresno

Pravachan Hegde, MD, is an Associate Clinical Professor of Medicine, UCSF in the division of Pulmonary & Critical Care Medicine with an area of concentration in Interventional Pulmonology at UCSF Fresno.

He completed his fellowship in Pulmonary and Critical Care Medicine at Medical College of Wisconsin. He subsequently went on to finish another advanced fellowship in Advanced Interventional Thoracic Endoscopy/Interventional Pulmonology from the division of Thoracic Surgery at University of Montreal. Dr. Hegde is also interested in clinical research related to lung cancer, advanced devices, and Interventional Pulmonology.

PLEUROSCOPY AT "BEDSIDE"

PRAVACHAN HEGDE, MD DAABIP

DIRECTOR – INTERVENTIONAL PULMONOLOGY

ADVANCED INTERVENTIONAL THORACIC ENDOSCOPY

UCSF Fresno

California Thoracic Society

RELEVANT FINANCIAL DISCLOSURES

- I have the following relationships with ACCME defined ineligible companies: Monarch Robot (J & J), Galaxy Robot (Noah) and BIODESIX - Consultant

- I WILL discuss off-label use and/or investigational use of any drugs or devices.

OBJECTIVES

At the conclusion of this activity, participants will :

- Recognize the limited indications of Bedside Pleuroscopy after understanding the techniques, clinical applications, contraindications and complications of Medical Thoracoscopy / Pleuroscopy (MT)

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INTRODUCTION

- Pleural Effusion*
  - 1.5 million new / year
  - 180,000 thoracentesis / year
  - Presumptive diagnosis only in 59% - 63 %
- Thoracoscopy – Higher yield
  - Medical Thoracoscopy / MT (Semi rigid or rigid)
  - Surgical (VATS)

* Feller-Kopman D. Ultrasound guided thoracentesis. Chest .2006:129(6):1709-1714

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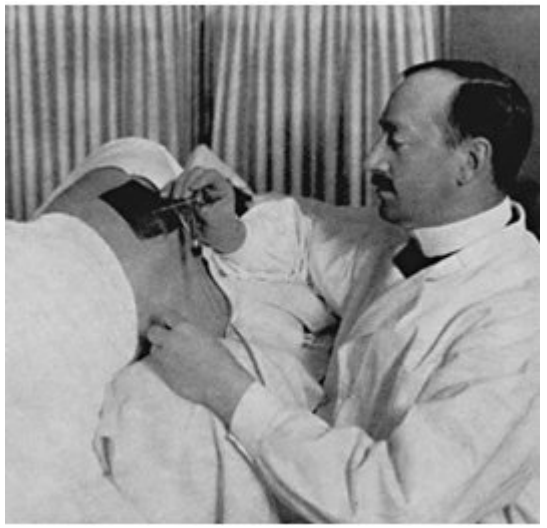
HISTORY OF MT

- Richard Cruise in 1866 examined a empyema in a girl
- Hans Christian Jacobaeus, internist in 1910 used a Cystoscope !
- Pre-antibiotics era, MT was primary treatment of TB
- Streptomycin discovered in 1943 made MT obsolete
- Boutin & Brandt revived MT in 1970s



TECHNIQUE

- Pre procedure checklist – Medication, labs
- (Platelets > 50 k and INR < 1.5), Imaging
- Ultrasound Exam – Volume, site and character
- Anticoagulants – 5 half lives
- OR or Endoscopy
- Moderate sedation or MAC

Anticoagulation	Time
Warfarin	5 days
Clopidogril/Prasugrel	5- 7 days
Dabigatran	2 – 4 days
Rivaroxaban	2-3 days
Apixaban	1-2 days
Lovenox/Fondaparinux	24 hours
Integrelin	12 hours
Tirofiban	6 – 10 hours
Heparin	4 – 6 hours
Bivalirudin	2 – 4 hours

Alraiyes et al. Medical Thoracoscopy: Technique and Application. PLEURA. 2016;3.
DOI:10.1177/2373997516632752

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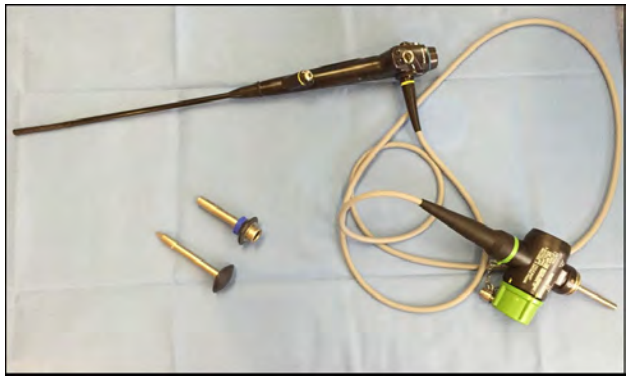
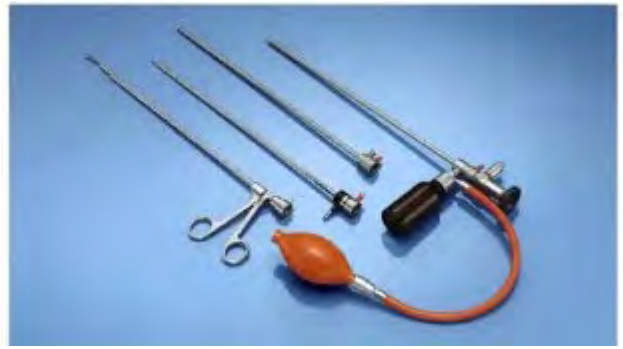
FLEX-RIGID VS RIGID

FLEX – RIGID (Discontinued in US)	RIGID
22 cm proximal, 5 cm distal, 7 mm OD, 8 – 10 mm trocar	27 – 37 cm, 7 – 12 mm OD, straight / oblique, 5 – 13 mm trocar
More flexible	Limited flexibility
Can retroflex	Inability to retroflex
Connects to existing processors	Needs separate light source
Smaller samples	Bigger and deeper biopsies
Similar safety profile*	Similar safety profile*
Similar yield*	Similar yield*





*Mohan et al. Utility of semirigid thoracoscopy in the diagnosis of pleural effusions: a systematic review. J Bronchology Interv Pulmonol. 2010;17(3):195-201

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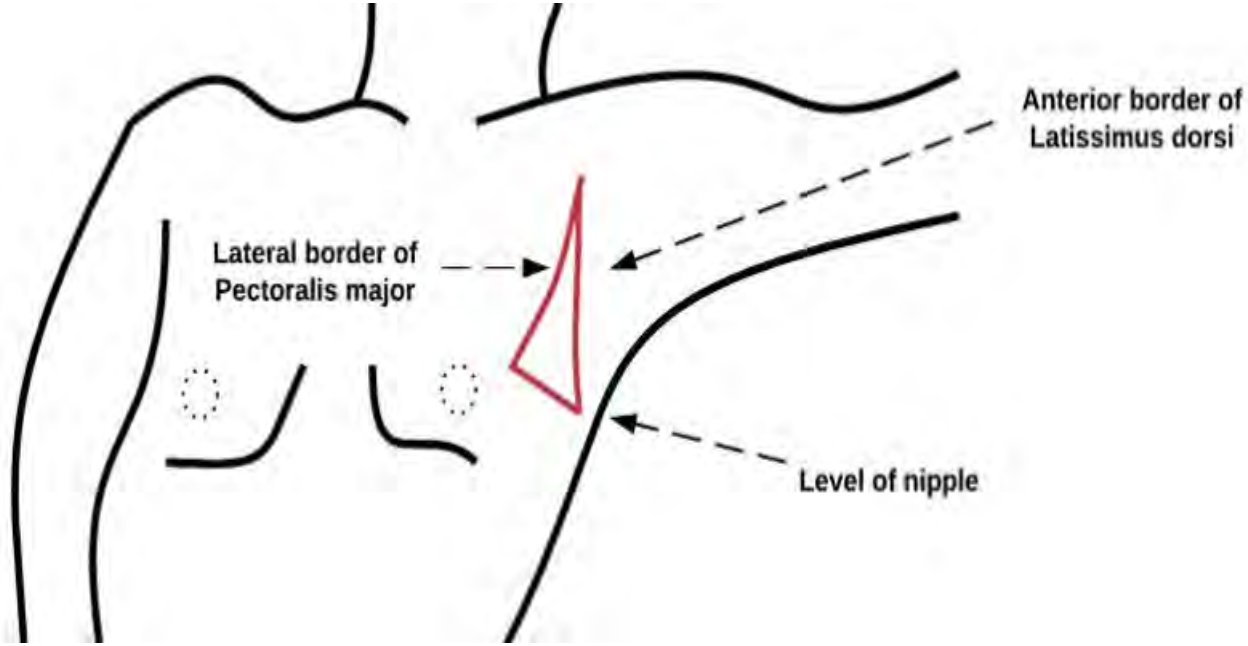
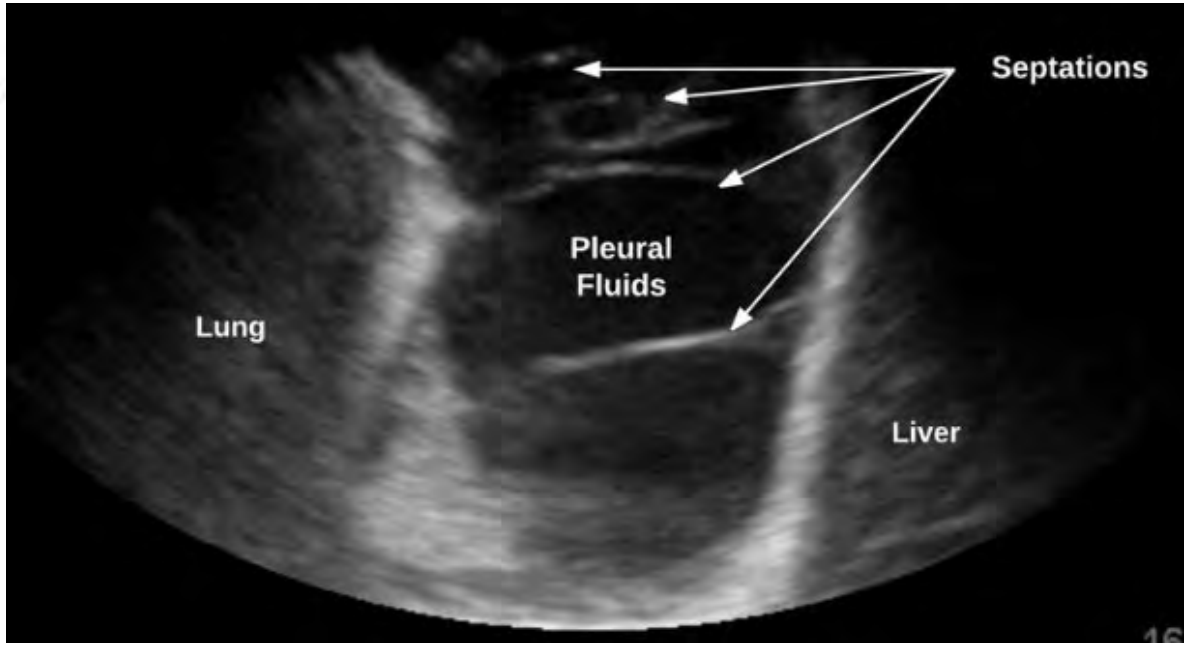
ANATOMY & TECHNIQUE





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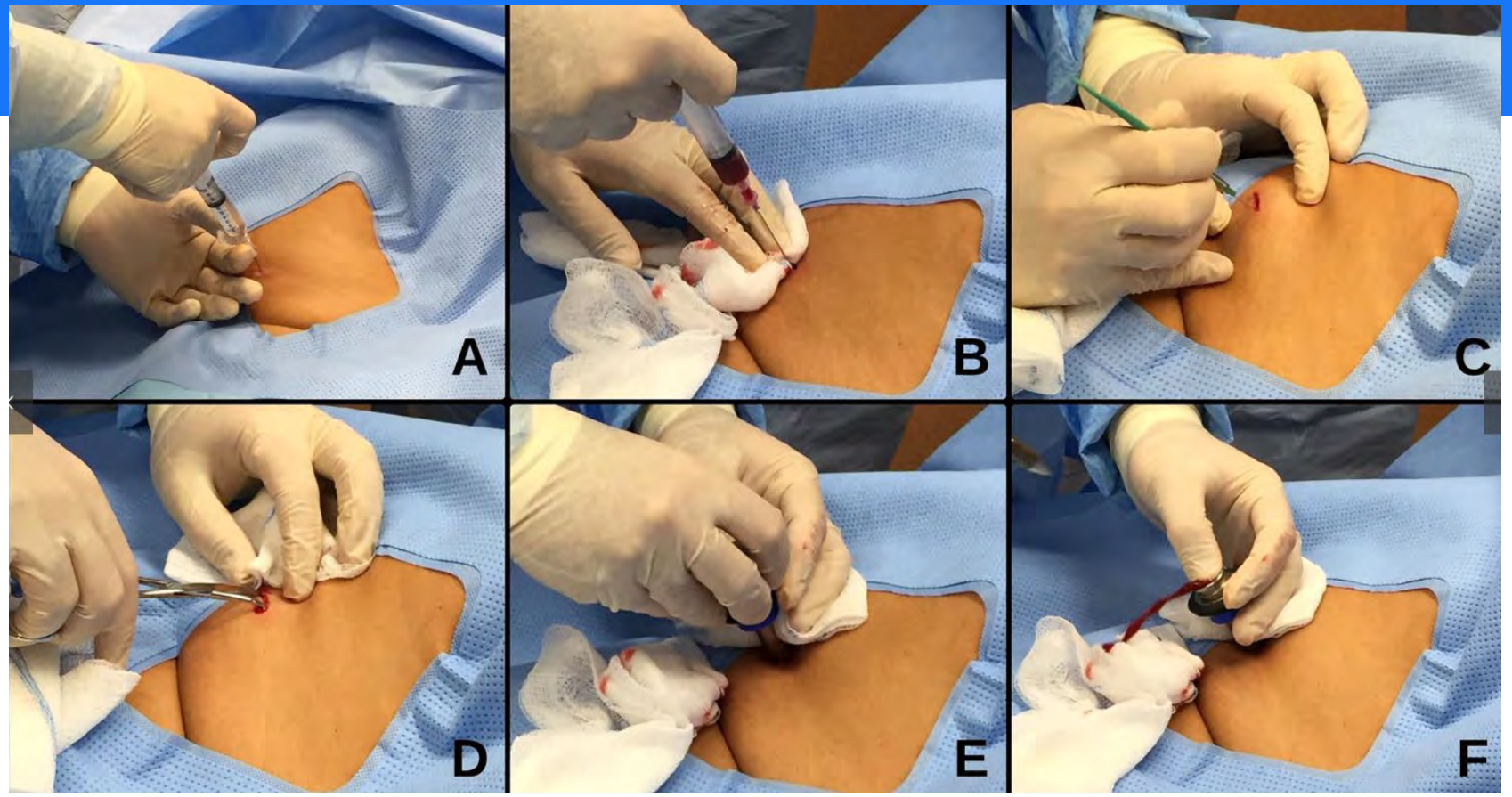
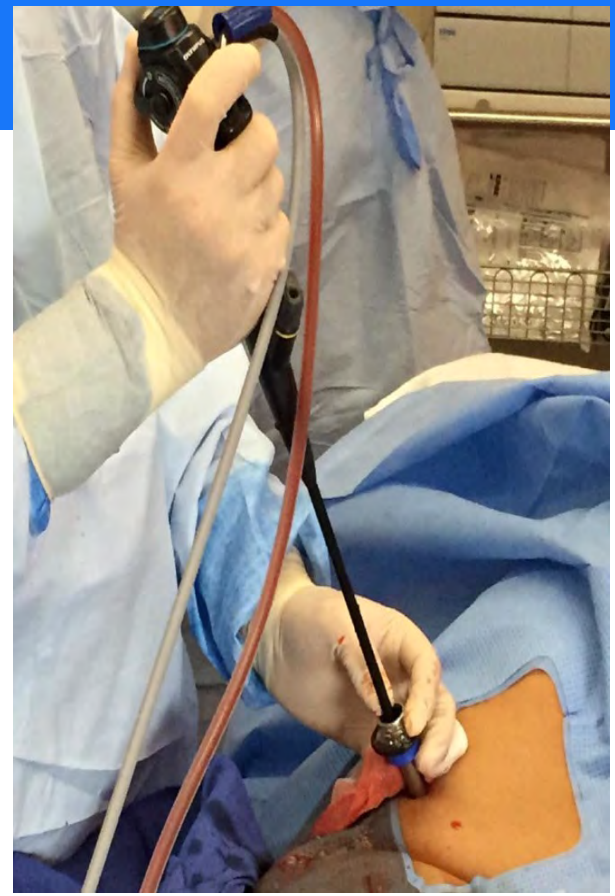
TECHNIQUE





Alraiyes et al. Medical Thoracoscopy: Technique and Application. PLEURA. 2016;3. DOI:10.1177/2373997516632752

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TECHNIQUE

- Second Entry Port
  - Complex loculated collections
  - Adhesionolysis
  - Bleeding control
- Induction of Pneumothorax
  - Boutin needle
  - Small effusions
  - Caution in poor lung function

Boutin needle

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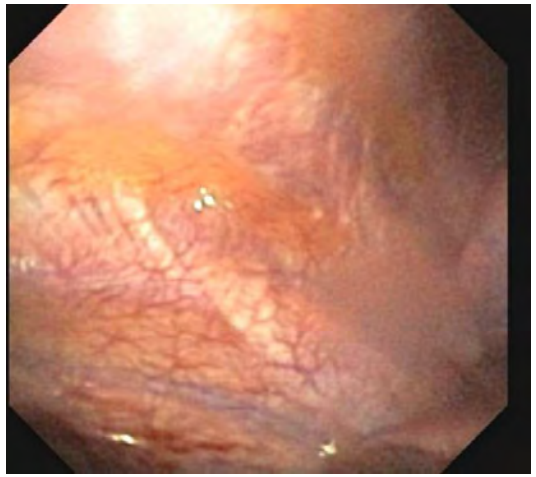
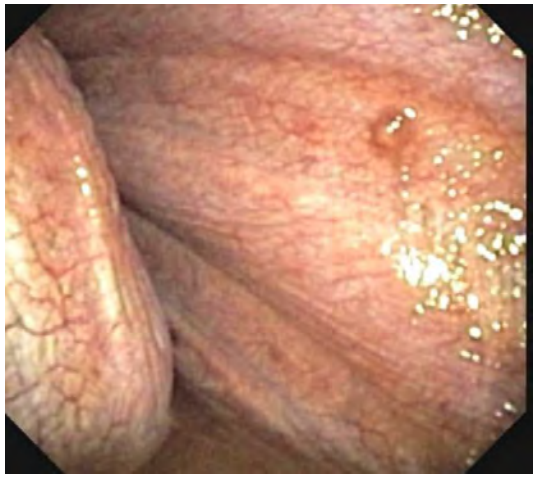
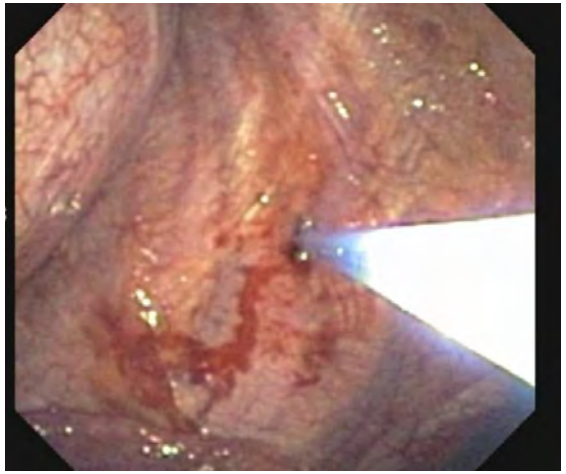
EXAMINATION AND PROCEDURE

- Visualization
  - Apex
  - Costal pleura
  - Diaphragm
  - Mediastinum
- Biopsy
  - 2 to 6 biopsies
  - Over the rib
  - Lift and peel
  - Can be painful
  - Electrosurgical biopsy – IT knife better yield compared to forceps*







* Sasada et al. A new electrocautery pleural biopsy technique using an insulated-tip diathermic knife during semirigid pleuroscopy. Surg Endosc. 2009;23(8):1901-1907

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CLINICAL APPLICATIONS OF MT

- Exudative effusion of unknown etiology

- Thoracentesis cytology 59% after repeated taps
- MT pooled sensitivity 97% and Specificity 100%*
- Comparable to VATS with 92% accuracy**

*Mohan A et al. Utility of semirigid thoracoscopy in the diagnosis of pleural effusions: a systematic review. J Bronchology Interv Pulmonol. 2010;17(3):195-201

**Beheshtirouy S et al. Video assisted rigid thoracoscopy in the diagnosis of unexplained exudative pleural effusion. J Cardiovasc Thorac Res. 2013;5(3):87-90

CLINICAL APPLICATIONS OF MT

- Malignant Pleural Effusion

- Pleural fluid cytology 51% first tap
- Additional 7% second tap and 2% third tap
- MT diagnostic yield is 95%
- Successful pleurodesis 90%
- Indwelling tunneled pleural catheter
- Catheter tract metastases in Mesothelioma

*Haridas N et al. Medical thoracoscopy vs closed pleural biopsy in pleural effusions: a randomized controlled study. J Clin Diagn Res. 2014;8(5):MC01-MC04

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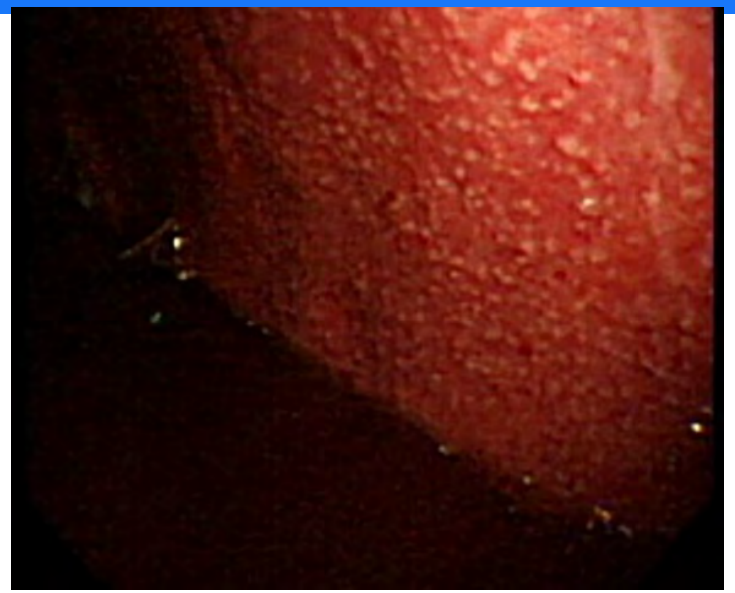
CLINICAL APPLICATIONS OF MT

- Tuberculosis

- AFB smear and culture 10 – 30% yield
- ADA will help
- Closed pleural biopsy + ADA 80 – 93% in endemic areas*
- MT 93 – 98% sensitive in endemic area*
- Diffuse Miliary nodules



* Diacon AH et al. Diagnostic tools in tuberculousis pleurisy: a direct comparative study. Eur Respir J. 2003;22(4):589-591

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CLINICAL APPLICATIONS OF MT

- Pneumothorax

- 5% recurrence rate of PTX after MT talc pleurodesis versus 34% with pleural drainage alone*
- Subpleural blebs
- Pleural porosity under autofluorescenece MT
- Poor VATS candidates
- COPD FEV1 < 40% – 95% success however 10 % 30 day mortality**

*Tschopp JM et al. Talcage by medical thoracoscopy for primary spontaneous pneumothorax is more cost-effective than drainage: a randomized study. Eur Respir J. 2002;20(4):1003-1009

**Lee et al. An audit of medical thoracoscopy and talc poudrage for pneumothorax prevention in advanced COPD. Chest. 2004;125(4):1315-1320

WHAT ABOUT MT IN EMPYEMA ?

- Empyema and Complicated Parapneumonic Effusion

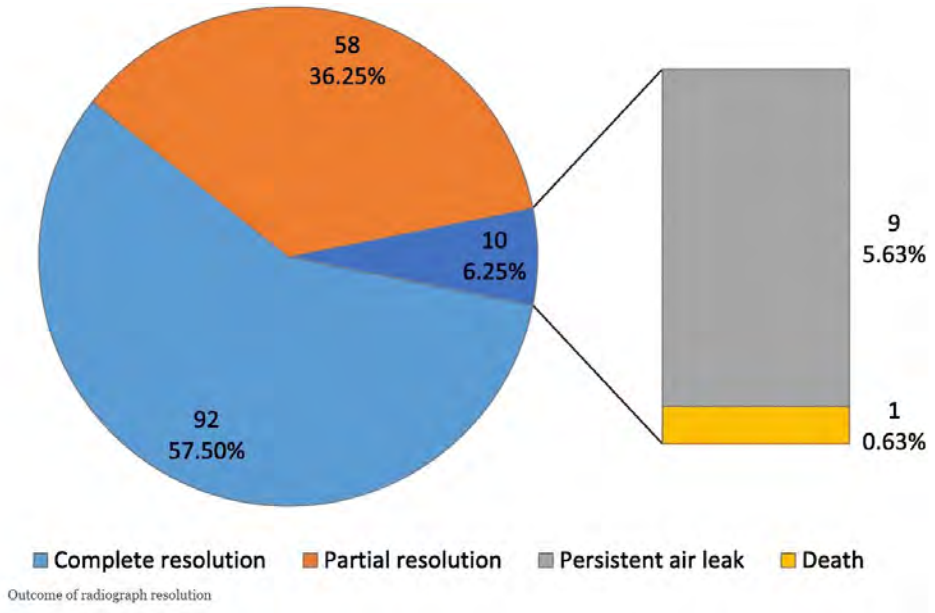
- Indication, benefit and use not well defined
- Retrospective studies – MT successful in 86 – 91%
- 6 – 14 % needed further surgical intervention
- 7% complication (cutaneous fistula, hemothorax, pneumothorax and SQ emphysema)

*Brutsche MH et al. Traetment of sonographically stratified multiloculated thoracic empyema by medical thoracoscopy. Chest. 2005;128(5)3303-3309

*Ravaglia C et al. Is medical thoracoscopy efficient in the management of multiloculated and organized thoracic empyema ? Respiration. 2012;84(3):219-224

MT IN EMPYEMA

- 160 patients with multi-loculated / septated empyema on US
- Prolonged presentation > 30 days
- No response to abx, failure of tube thoracostom
- Organized Stage 3 empyema was excluded
- 63% had TB



*Sumalani KK et al. Role of medical Thoracoscopy in the management of Multiloculated Empyema. BMC Pulm Med 18, 179 (2018).

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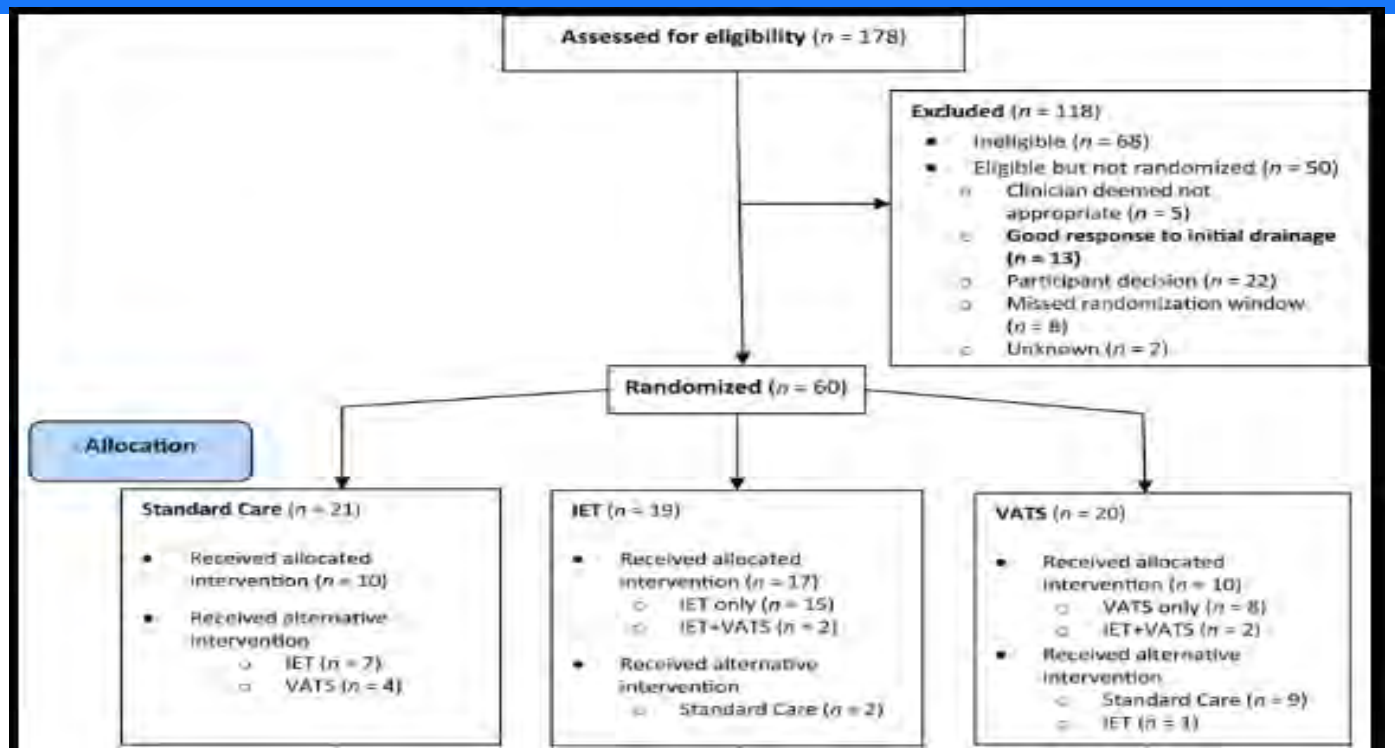
MT IN EMPYEMA

- UCLA IP team Dr Ranaughi and collegues (Unpublished data)
- 37 patients with empyema, average age 72 years who failed tube thoracostomy
- 21 patients got MIST prior
- 36 had chest tubes removed and discharged home
- 1 needed VATS
- LOS median 10.3 days
- No mortality or complications / prolonged air leak

? EARLY VATS FOR EMPYEMA – MIST 3

- MIST 3 – feasibility study

- 3 arms within 24 hours
- LOS – longer in standard of care group



*Bedawi et al.Early Video-assisted Thoracoscopic Surgery or Intrapleural Enzyme Therapy in Pleural Infection: A Feasibility Randomized Controlled Trial. The Third Multicenter Intrapleural Sepsis Trial – MIST 3. AJRCCM. 2023 Dec

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CONTRAINDICATIONS TO MT

Absolute

- Lack of pleural space
- Advanced empyema
- Pleural thickening
- Previous pleurodesis
- Mesothelioma with fused pleural surfaces

Relative

- Intolerable hypoxemia
- Unstable hemodynamics
- Bleeding diasthesis
- Refractory cough
- Inability to tolerate lateral decubitus
- PH
- Severe obesity

COMPLICATIONS OF MT

- Mortality 0.69 %
- Major complications 1.8%
  - Hemorrhage, BPF
- Minor complications 7.3%
  - SQ emphysema, minor bleeding, skin site infection, hypotension
- Flex-rigid has lower complication rate compared to rigid (3% vs 5%)
- ICA injury 4%

*Rahman NM et al. British Thoracic Society Pleural Disease Guideline Group. Local anaesthetic thoracoscopy: British Thoracic Society Pleural Disease Guideline 2010. Thorax. 2010

"BEDSIDE" THORACOSCOPY ?

- Is this indicated ?
- Is this the standard of care ?

"BEDSIDE" THORACOSCOPY

- Ooi et al – 25 patients
- Flexible scope
- 16 F pigtail

Etiology	*n* (%)
Malignancy (%)	15 (60)
Pleural metastatic tumor	14 (56)
Lung cancer	11 (44)
Breast cancer	1 (4)
Hepatoma	1 (4)
Esophageal cancer	1 (4)
Mediastinal tumor	1 (4)
Benign (%)	10 (40)
Infection	9 (36)
Parapneumonic effusion	4 (16)
Empyema	3 (12)
TB pleurisy	2 (8)
Others: traumatic hemothorax	1 (4)

Data are expressed as number of patients (%). TB: Tuberculosis

Complication	*n* (%)
Major (%)	0
Bleeding	0
Death (procedure-related)	0
Minor (%)	11 (44)
Wound pain	6 (24)
Subcutaneous emphysema	3 (12)
Hypotension (periprocedure)	1 (4)
Wound infection (drain site)	1 (4)
Dislodged drain	0
Pneumonia/empyema	0
Procedure abandoned	0

Data are expressed as number of patients (%)

Ooi H. Bedside pleuroscopy in the Intensive Care Unit. Apr-Jun;30(2):PMID: 29875590.

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" BEDSIDE " PLEUROSCOPY

- Case reports*
- Complicated Parapneumonic effusion / empyema for chest tube placement for MIST in a non-surgical patient
- Chemical pleurodesis with MT in a patient with persistent air leak
- CAUTION – Complications can happen
- Better to do it in a controlled setting which operator is used to
- Just because we can, should we ?
- Is it indicated ? Is this the standard of care ?

*Thakore S, Alraiyes AH, Kheir F. Medical thoracoscopy in intensive care unit. J Thorac Dis. 2021 Aug; PMID: 34527362

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TAKE HOME POINTS

- LIMITED INDICATIONS FOR BEDSIDE PLEUROSCOPY IN ICU

- Positioning a chest tube in a loculated empyema for MIST therapy in a non surgical patient who cannot be mobilized due to hemodynamic instability
- Limited small studies with selection bias show that MT can be safely performed at bedside in ICU

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THANK YOU

Email : Pravachan.hegde@ucsf.edu

Questions ?

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Pro: A Surgical Approach is First Line for Lung Entrapment?

Jeffrey B. Velotta, MD, FACS
Physician
Kaiser Oakland

Dr. Jeffrey Velotta, MD, FACS is a thoracic surgeon at Kaiser Permanente Oakland Medical Center, an adjunct Clinical Assistant Professor in the Department of Surgery at the University of California, San Francisco (UCSF) School of Medicine, and Clinical Professor in the Department of Clinical Science at the Kaiser Permanente Bernard J. Tyson School of Medicine. Dr. Velotta's clinical and research interests involve innovative techniques and regionalization pathways for lung cancer, esophageal cancer, and mesothelioma.

CALIFORNIA THORACIC SOCIETY ANNUAL MEETING 2024

PRO: A SURGICAL APPROACH IS FIRST LINE FOR LUNG ENTRAPMENT

Jeffrey B. Velotta, MD, FACS

Division of Thoracic Surgery

Kaiser Permanente Oakland Medical Center

Clinical Professor, Kaiser Permanente Bernard J. Tyson School of Medicine

Clinical Assistant Professor, UCSF Surgery

March 9, 2024

@JVelottaMD

KAISER PERMANENTE
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RELEVANT FINANCIAL DISCLOSURES

- I have no relationships with ACCME defined ineligible companies

- I WILL NOT discuss off-label use and/or investigational use of any drugs or devices.

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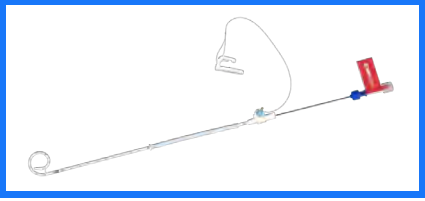
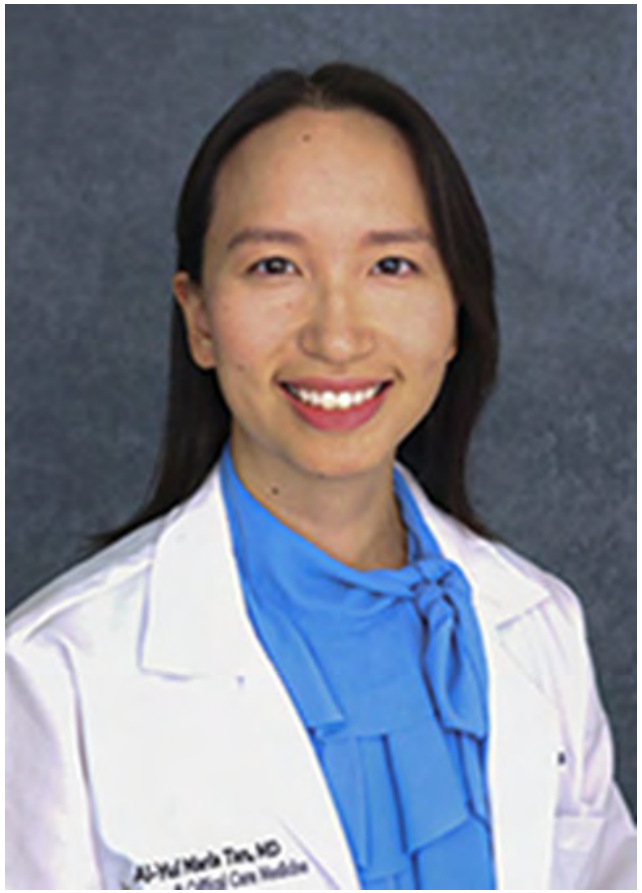
UCLA Health



Cedars Sinai



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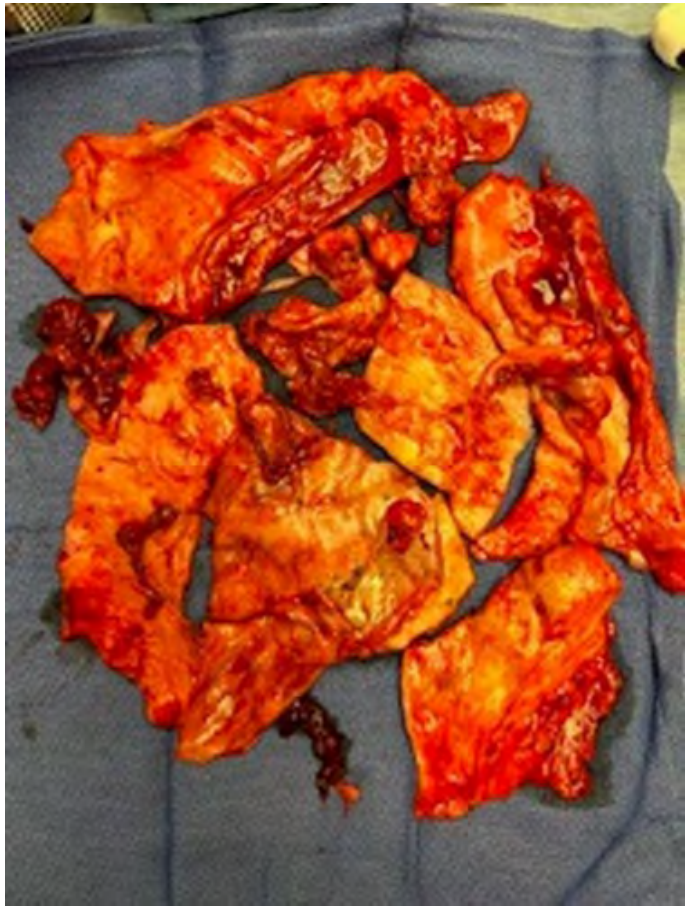
OUTLINE

- Background
- Guidelines – Favor Surgery First
- Cases
- MIST-3 and Real-World Fibrinolytic Data
- Take Home Points



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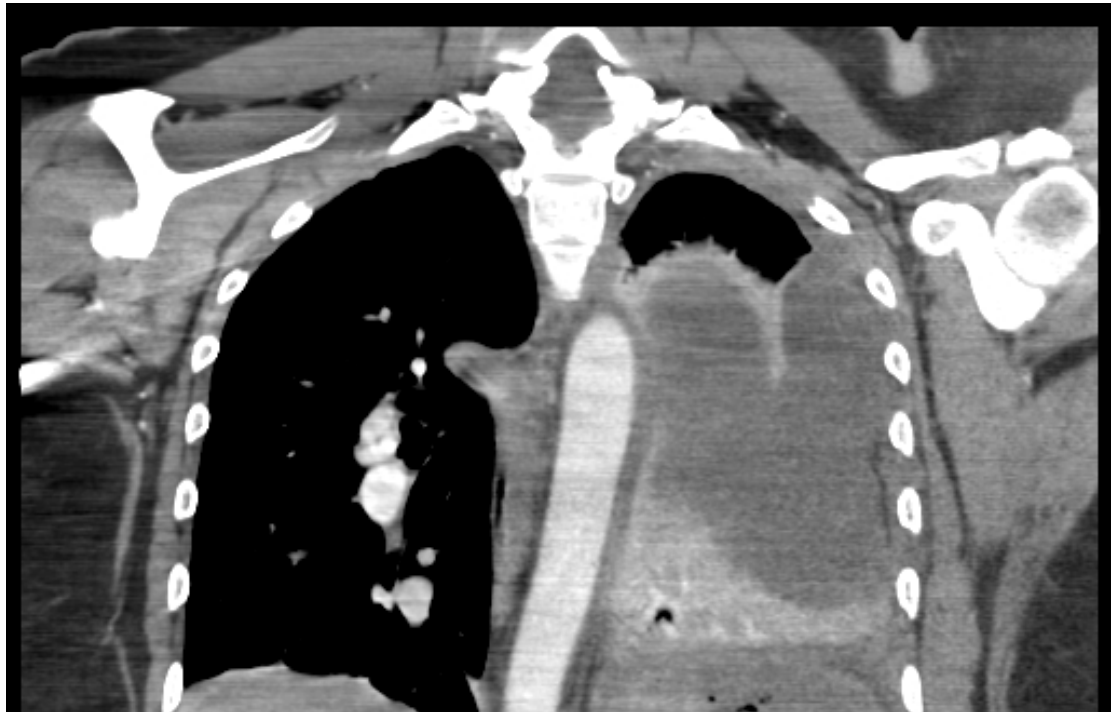
BACKGROUND

- > 1 million patients hospitalized for pneumonia in the USA per year
- 20% – 40% will have parapneumonic effusions – **increasing (5-10% empyema)**
- Median LOS: 12 – 15 days
- 15 - 20% in-hospital mortality
- $40,000 in medical costs per patient



AATS Consensus Guideline 2017
JAMA Netw Open. 2023;6

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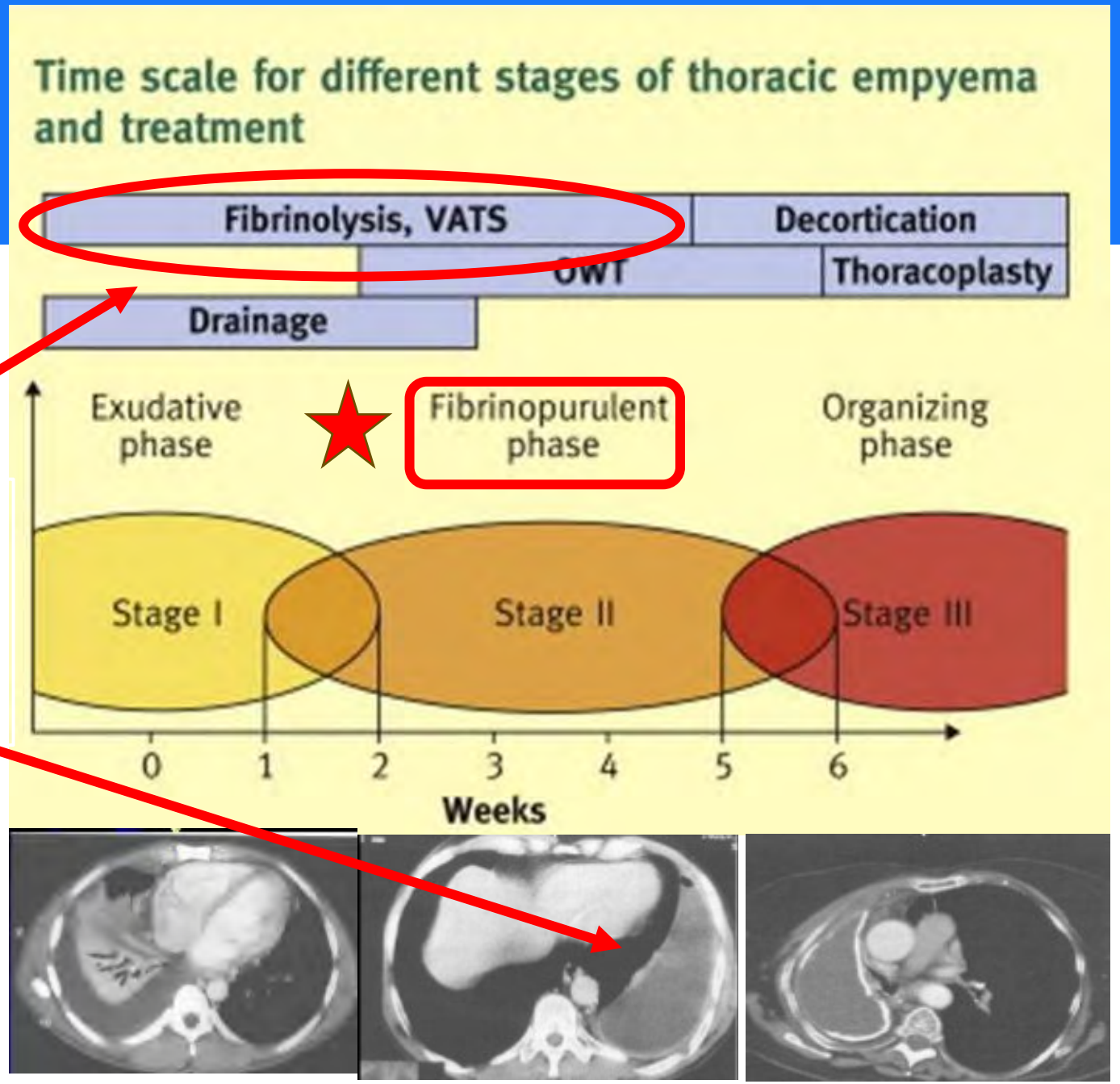
Stage II:
What is the best treatment?



Eur J Cardiothoracic 2007; 32

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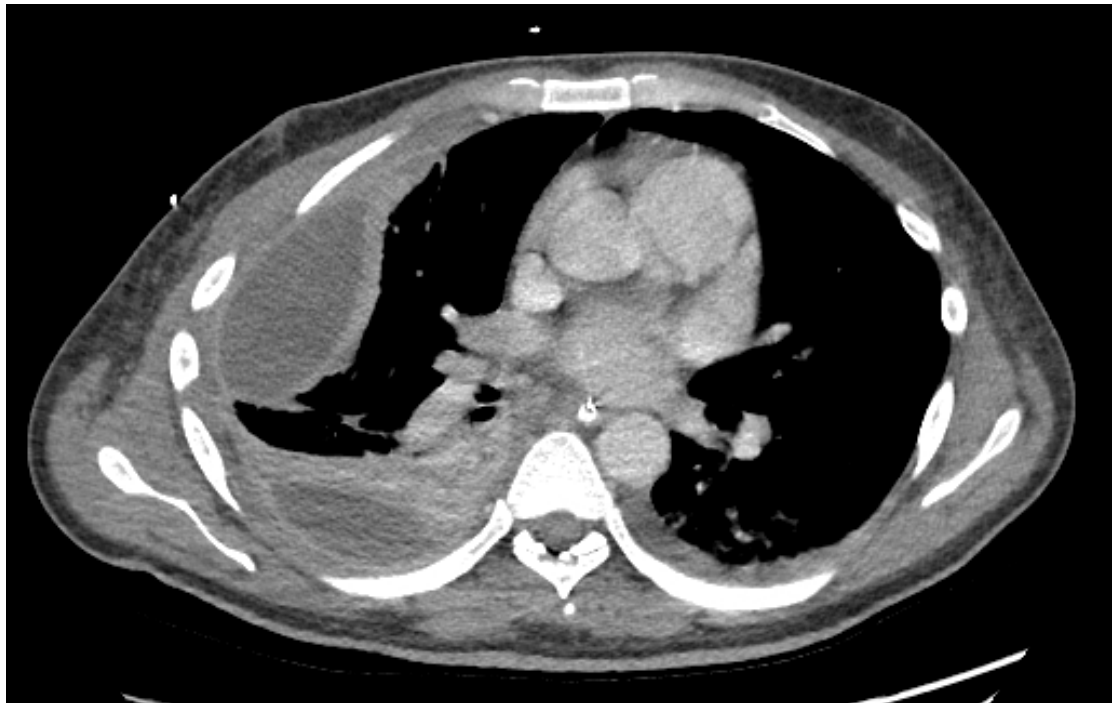
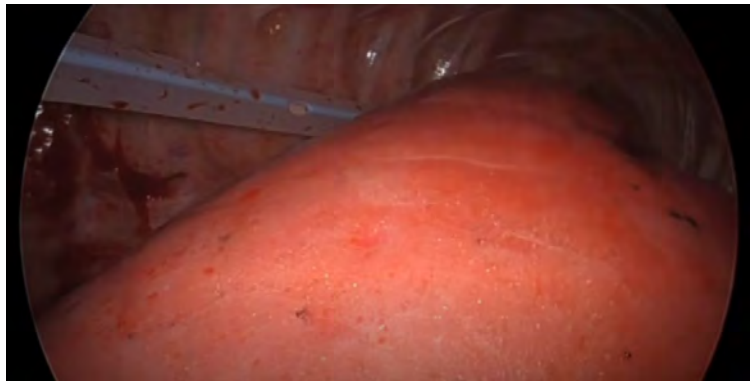
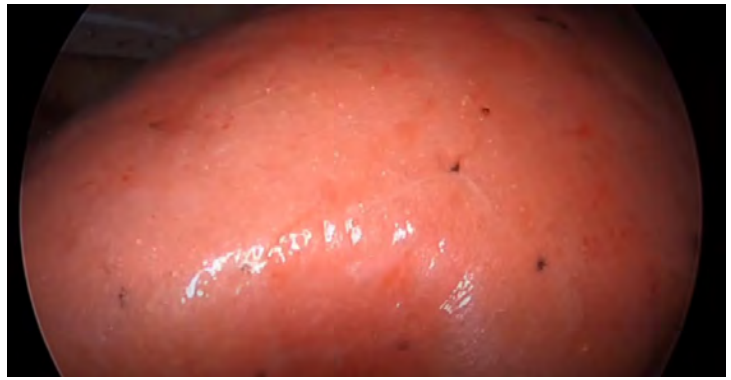
GOALS OF EACH TREATMENT – SURGICAL OR NON-SURGICAL

Drainage of infected space



Re-expansion of lung





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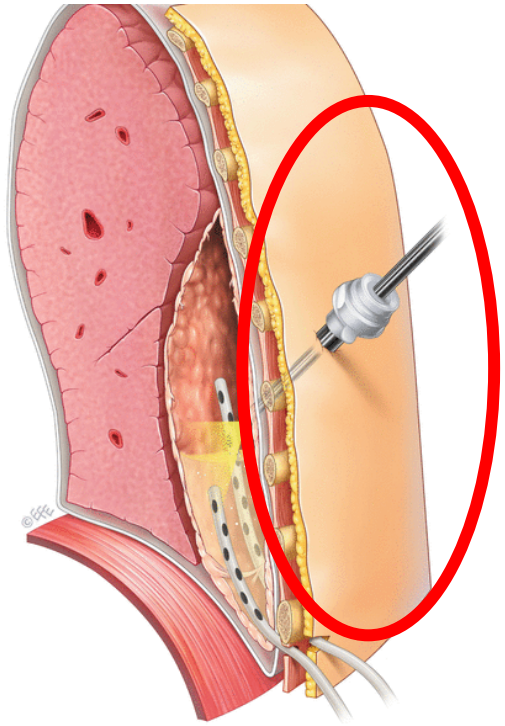
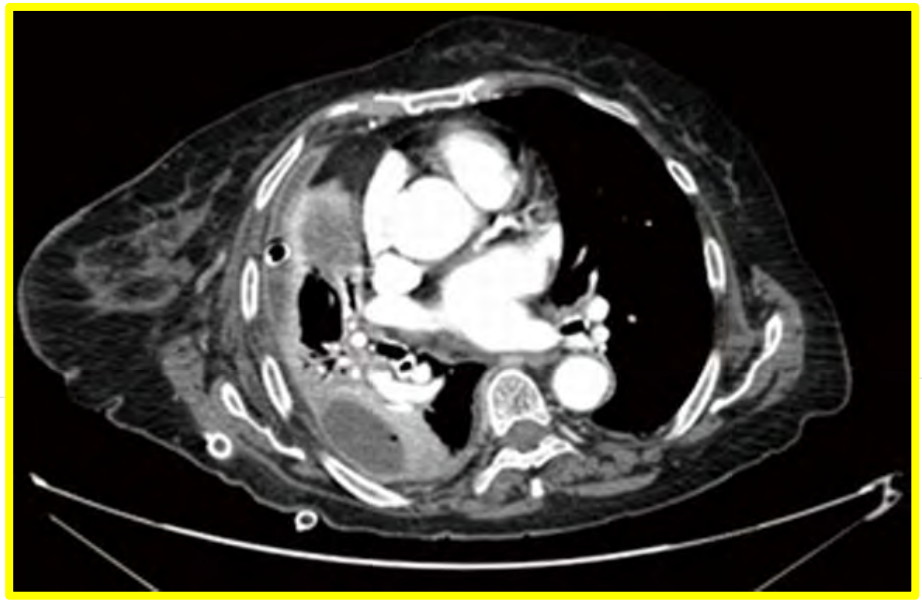
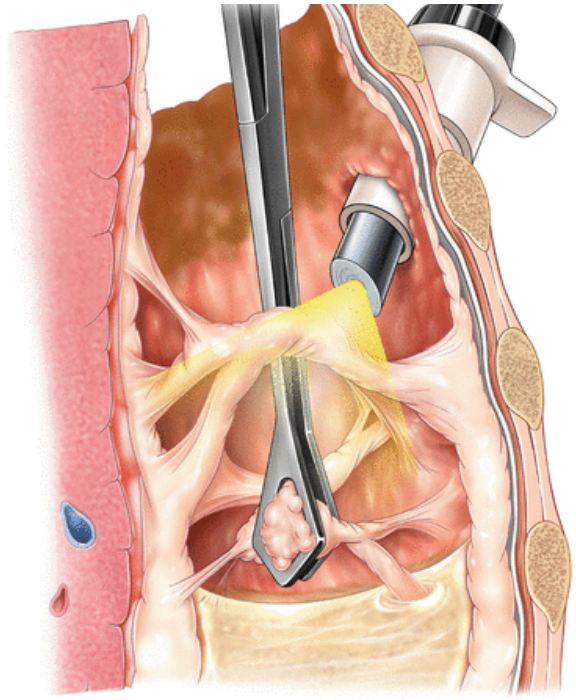
MINIMALLY INVASIVE LUNG DECORTICATION







Ann Thor Sur 2015

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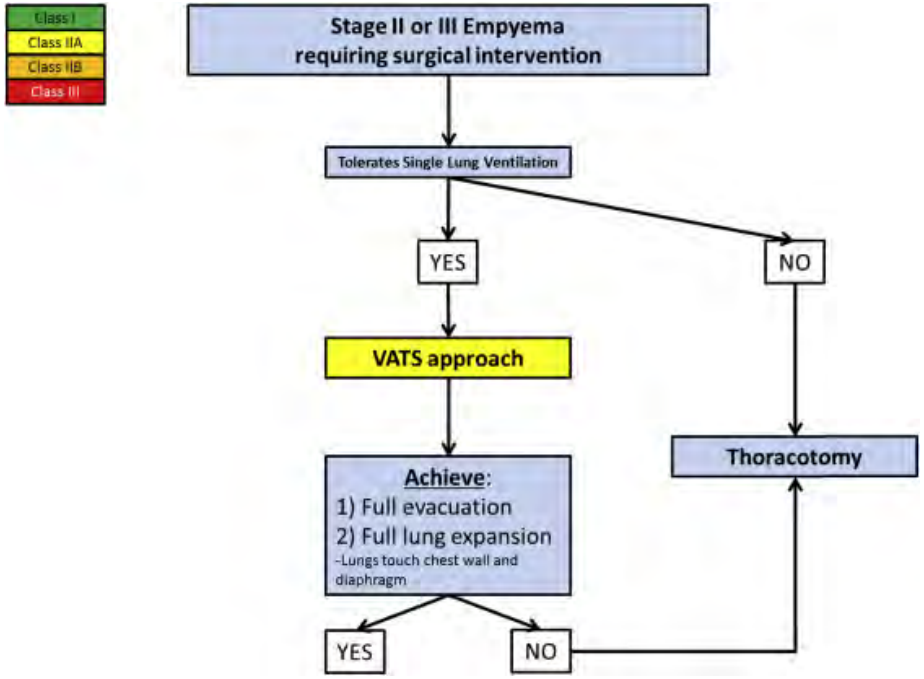
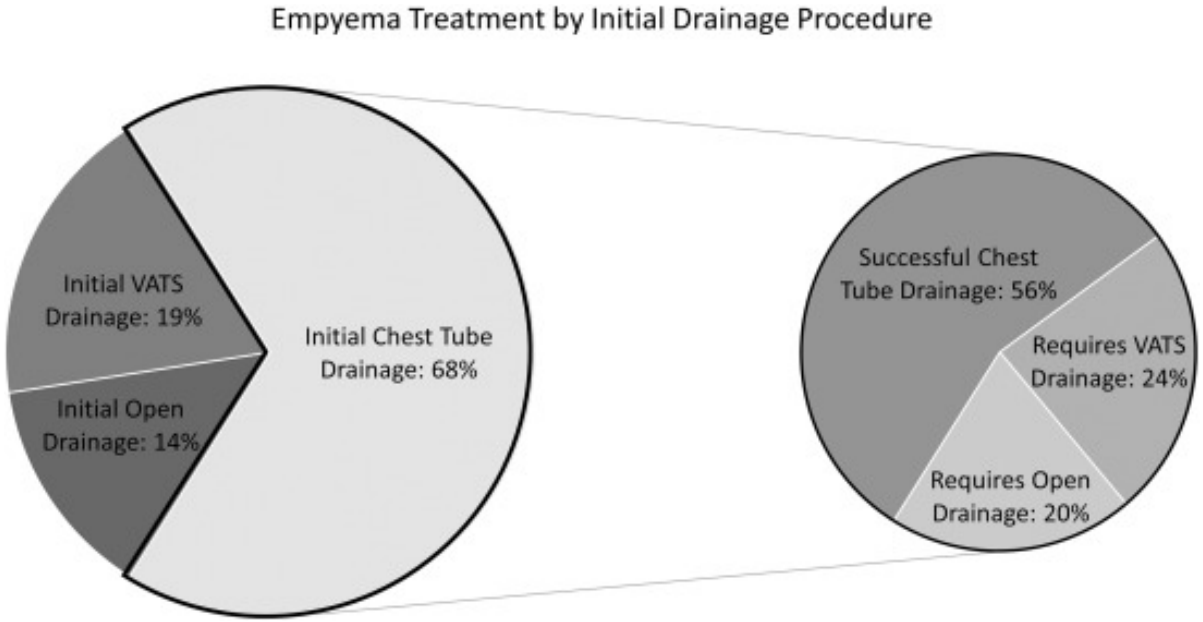
CURRENT GUIDELINES FOR COMPLICATED PLEURAL INFECTIONS

AATS 2017: **Stage II** empyema: VATS first line, NOT fibrinolytics



STS 2018: Earlier VATS may be beneficial for empyema, higher readmission and reintervention rates w/ non-op



JTCVS 2017
Ann Thorac Surg 2018

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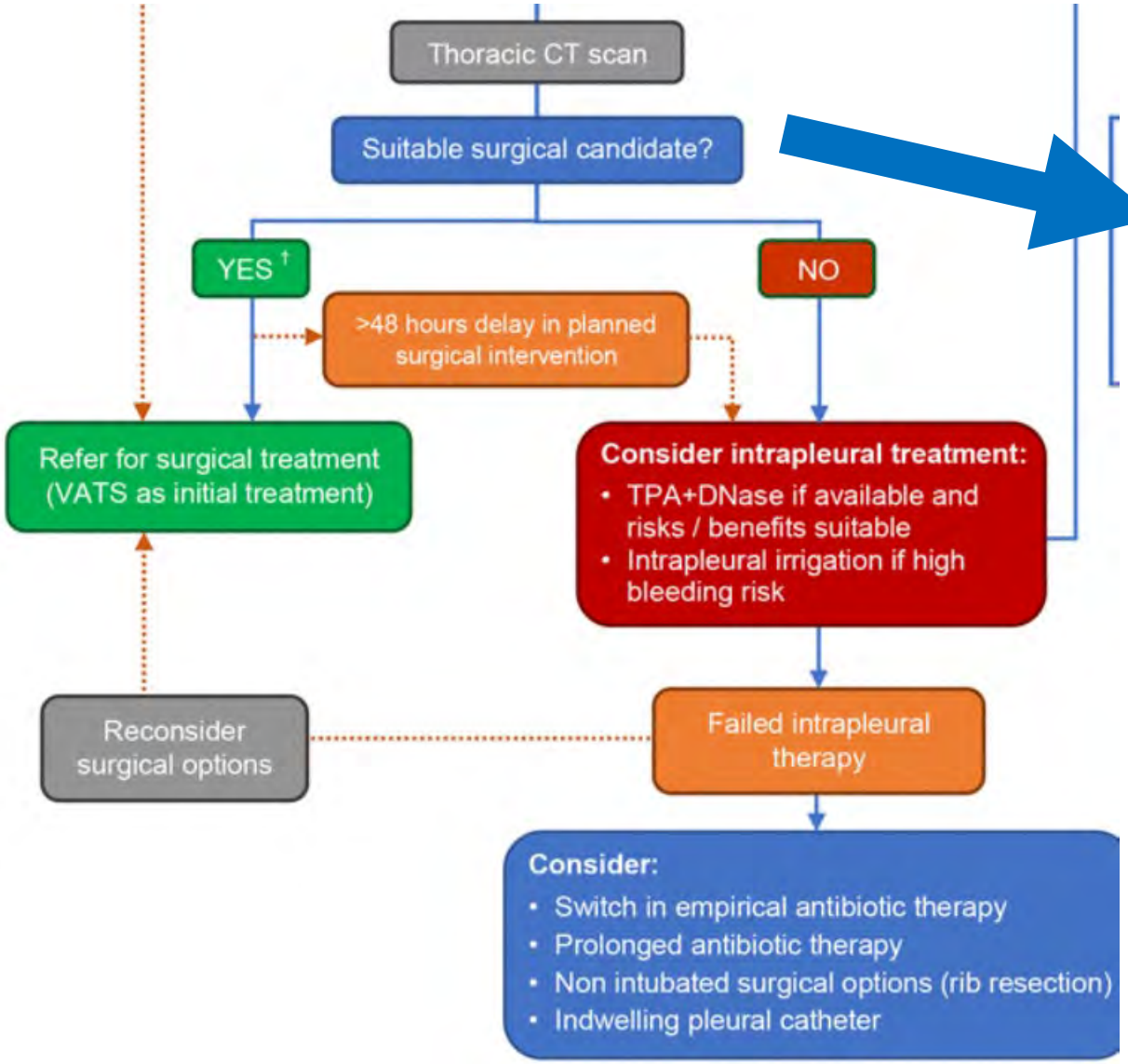
BTS Guideline: Management of pleural infection



Is the patient fit for an operation?

Guideline summary

British Thoracic Society Guideline for pleural disease

Mark E Roberts,[1] Najib M Rahman ,[2,3,4] Nick A Maskell,[5] Anna C Bibby,[5] Kevin G Blyth ,[6,7] John P Corcoran ,[8] Anthony Edey,[9] Matthew Evison ,[10] Duneesha de Fonseka ,[11] Rob Hallifax,[12] Susan Harden,[13] Iain Lawrie,[14] Eric Lim,[15] David McCracken,[16] Rachel Mercer,[17] Eleanor K Mishra ,[18] Andrew G Nicholson,[19] Farinaz Noorzad,[20] Kirstie S Opstad,[21] Maria Parsonage,[22] Andrew E Stanton ,[23] Steven Walker[5]

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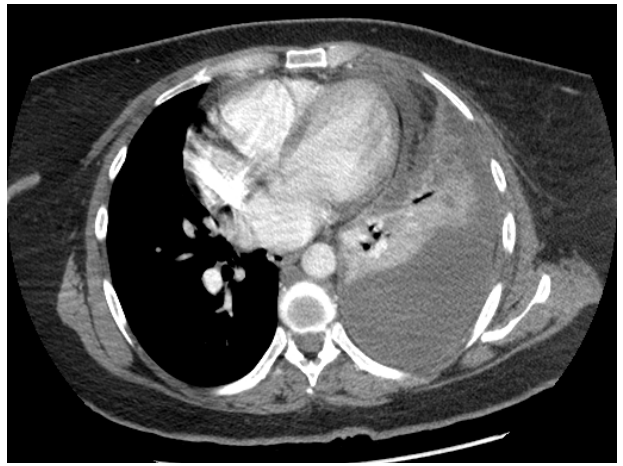
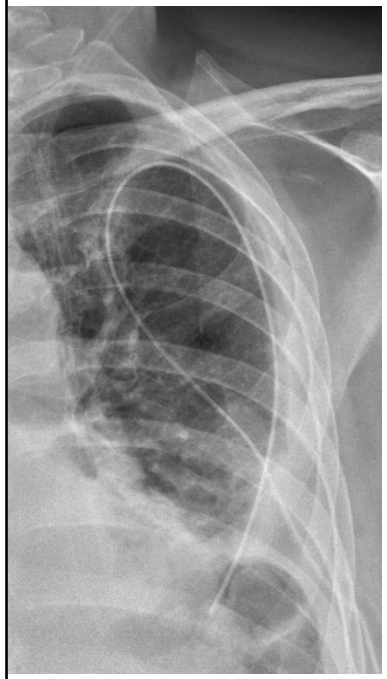
40F MORBID OBESE, DM, +TOB: LEFT EMPYEMA S/P L VATS DECORTICATION

PRE-OP



D/c home POD 2



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