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Passion for life

Evidence-Based Care of Patients with Chest Tubes

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2016 AACN NTI ExpoEd

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Learning Objectives

After attending this session, learners should be able to…

…compare traditional practices with evidence-based practices

…develop evidence-based standards of practice for patients with chest tubes

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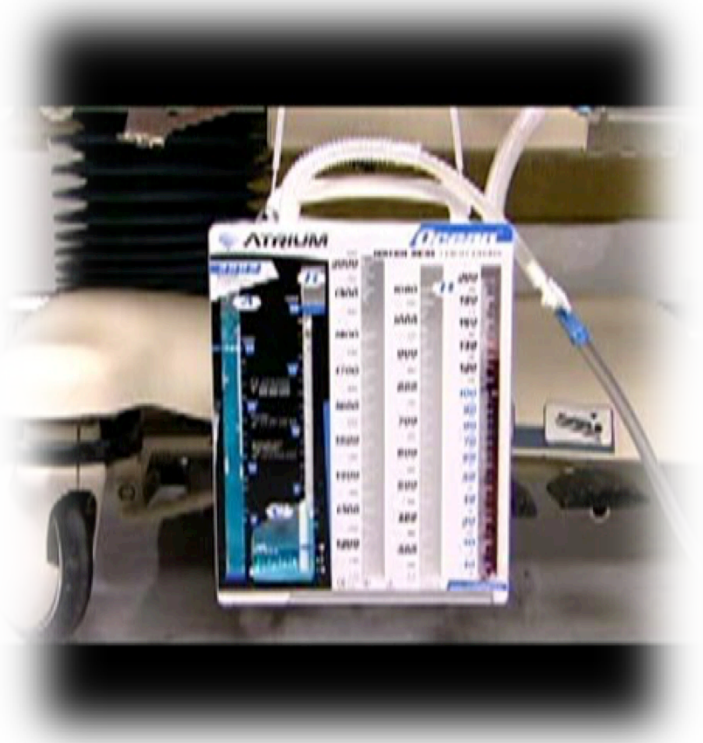
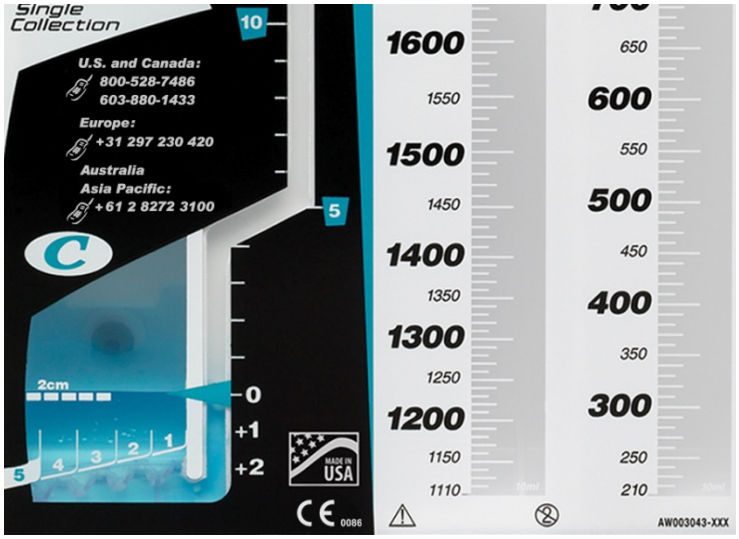
Tradition or Science?

- Chest drains need to be connected to vacuum source
- Set drain suction levels at -20 cmH_2O
- Maintain routine suction until chest tube removal



Tradition or Science?

- Chest tubes should not be removed until bubbling stops in water seal
- Chest x-rays should be obtained after pleural tube removal to check for residual pneumothorax



Tradition or Science?

- Regular chest tube manipulation (milking) is the most effective way to ensure drainage
- Dressings around chest tubes should start with petroleum gauze

What is Evidence?

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"A problem solving approach to clinical decision making...that integrates the best available *scientific* evidence with the best available *experiential* evidence."

Evidence ≠ Research

- Research answers a specific question about a specific population under certain conditions
- Evidence includes clinical guidelines, literature reviews, position papers, regulations, QI data, expert opinions, patient experience, clinician judgment & expertise

Johns Hopkins Nursing Evidence-Based Practice Model and Guidelines 2007

Continuum of Evidence

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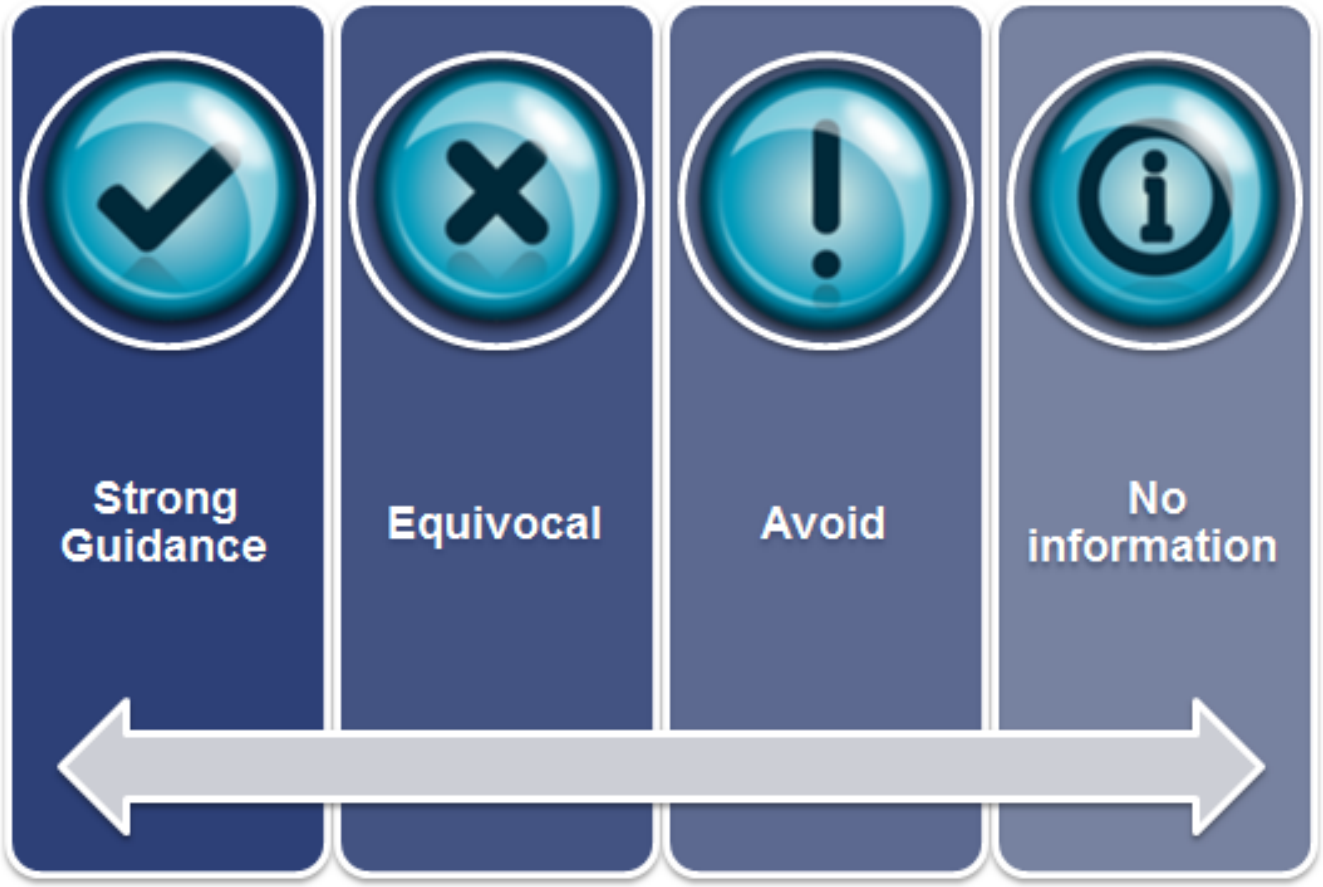

Drain suction level

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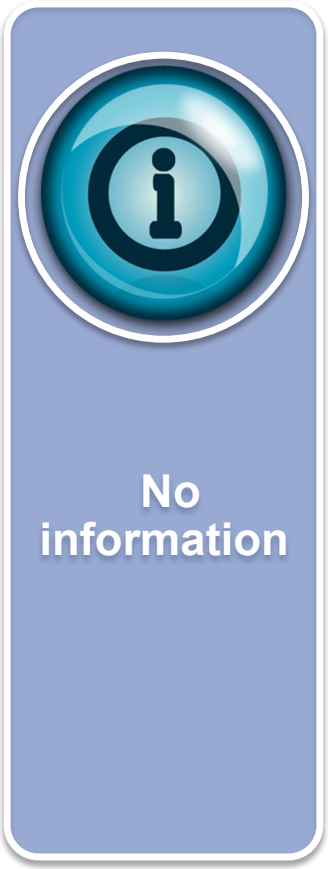
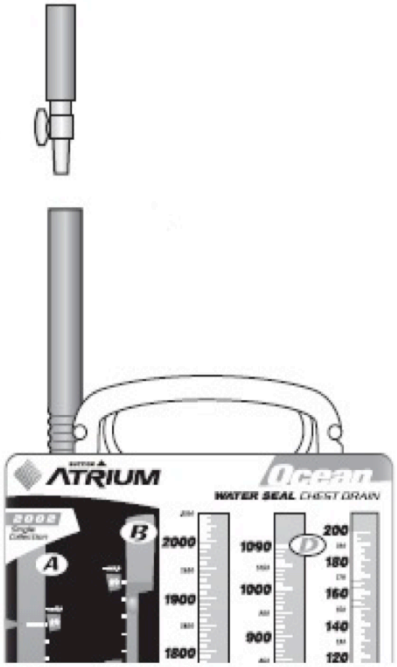
- No research, published on best suction levels
- Probably originated from height of glass bottles[1]



1. Carroll

Strong Evidence

- In routine cases, chest tube duration and LOS significantly reduced with minimal or no suction (i.e., gravity drainage)[2-4]
- Without suction, patient not tethered to the wall; ambulation contributes to quicker recovery
- Even when chest drain measures are equivalent, overall care favors gravity to allow ambulation

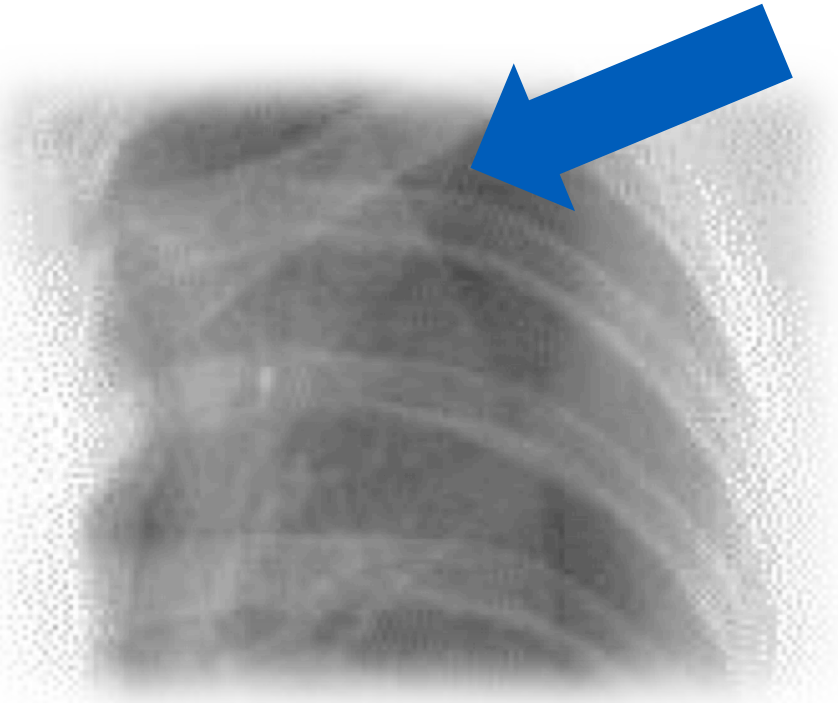


Strong Guidance

2.Coughlin, 3. Deng, 4.Morales

Pathophysiology

- Suction pulls greater volume of air through opening in lung tissue
- If air is moving through opening, it separates tissue, which then cannot come together and heal[5]
- Hypothesis that suction promotes faster leak closure disproven in trauma study[4]
- Increased fluid drainage: pleural irritation & weeping – not better drainage[6]



4.Morales, 5.Prokakis, 6. Dango

Lack of Lung Re-expansion[5]

- air leak
- other pleural deficit or
- atelectasis from small airway plugging?

Pleural deficit occurs when persons with COPD have resection and remaining lung does not immediately expand to fill space

Resection patients more likely to have COPD, so at greater risk for anesthesia effects on secretions

5. Prokakis

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New question: Is a residual pneumothorax after surgery less of a problem than continuing chest drainage with suction?

Asked another way:

How important is ambulating as soon as possible after lung resection?

2015 literature review found that even though evidence for not using suction in routine cases, “clinical practice is **not** aligned with the Level 1a evidence”[7]

7. Lang

Applying suction – Digital drains

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Digital drains allow for portable suction
Provide additional information about pleural air flow and pressures

2015 research compared digital drains with traditional drains after pulmonary resection[8,9,10]

- Chest tubes not removed sooner
- Length of stay the same
- Not worth the extra $

Concerns

- Is it just too much information to consider, not relevant to decision-making?
- Even with more info, can your workflow change to respond?

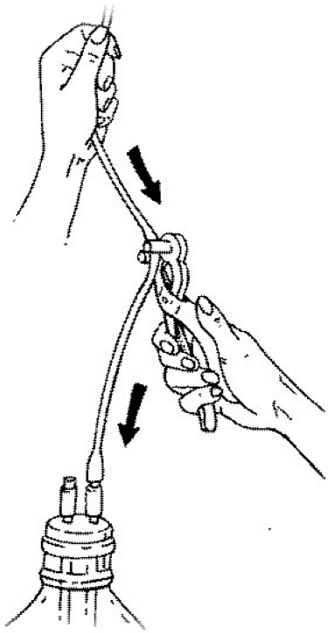
8. Gilbert, 9. Lijkendijk, 10. Rodriguez

Goal of stripping, milking, fan-folding are to increase negative pressure to suck clots out of chest tube

Strong Evidence

Stripping produces dangerously high pressures (-400 cmH2O)[11]

Milking, fan-folding, and tapping are not standardized and hard to compare



Avoid

Strong Guidance

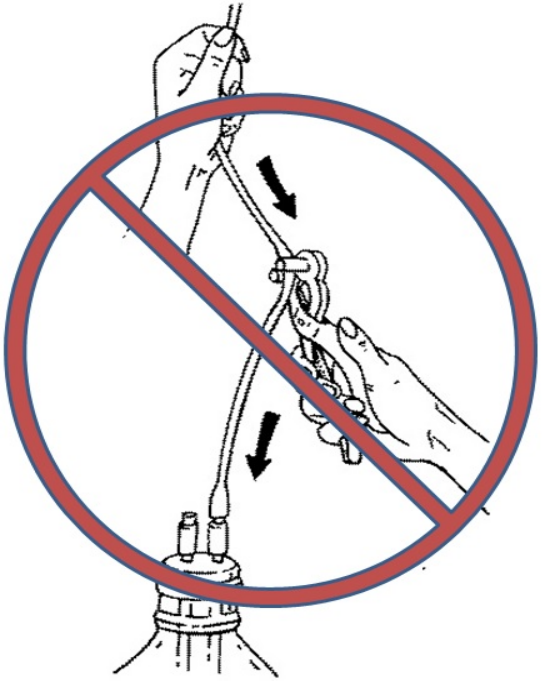
11. Duncan

Survey of Practice

72% of nurses reported they were not permitted to strip tubing

74% of surgeons allowed stripping for their patients[12]

Overall, studies show no advantage to tube manipulation to enhance drainage[13-16]



12. Shalli, 13. Day, 14. Halm, 15. Gordon, 16. Gross

Clots in chest tubes can occur inside the chest where they are not visible

- One study showed visible clots in lumen of tube in 33 of 158 pericardial tubes[17]
- Clots in portion inside the chest (at tube removal) in 39 tubes

2016 report of an intraluminal tube clearance device that was able to resolve tamponade signs: echocardiogram showing pericardial effusion & tachycardia[18]

Flow related to the 4th power of the radius, so if lumen is decreased 50%, flow reduced by 94%

17. Karimov, 18.Vistarini

Dependent Loops

- Position tubing and use physics and gravity to facilitate fluid drainage
- Dependent loop can change pleural pressure from -18 cmH_2O to +8 cmH_2O and **decrease fluid drained to zero** *in less than 30 minutes*[19]

Avoid dependent loops

19. Schmelz

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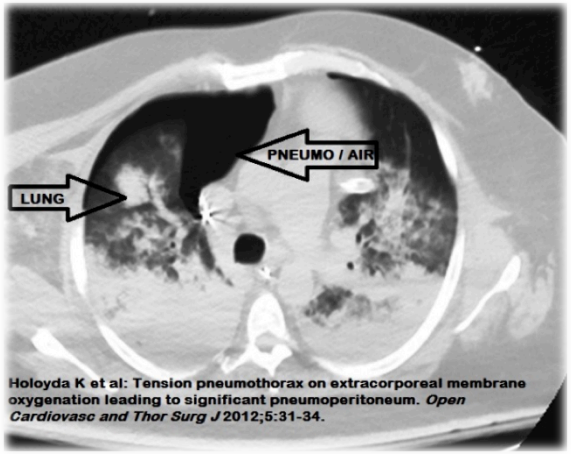
CT considered gold standard to detect pneumothorax

Occult pneumothorax is seen on CT but not on standard radiograph[20,21]

In trauma, 2% to 17%[22]

- If no CT, patient may have PTX we never know about; these patients were OK before CT was so common
- Evidence: watchful waiting



Strong Guidance

20. Ball, 21. Kirkpatrick, 22. Moore

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Ultrasound detects pneumothorax with the accuracy of CT when done by experienced professional[23-24]

- Ultrasound detects PTX not seen on radiograph
- No radiation with ultrasound
- Results in 4 to 11 minutes v. 79 to 166 minutes for radiograph[23]

From: Hakimisefat B, Mayo PH: Lung Ultrasonography. Open Crit Care Med J 2010;3,21-25

Strong Guidance

23. Saucier, 24. Goudie

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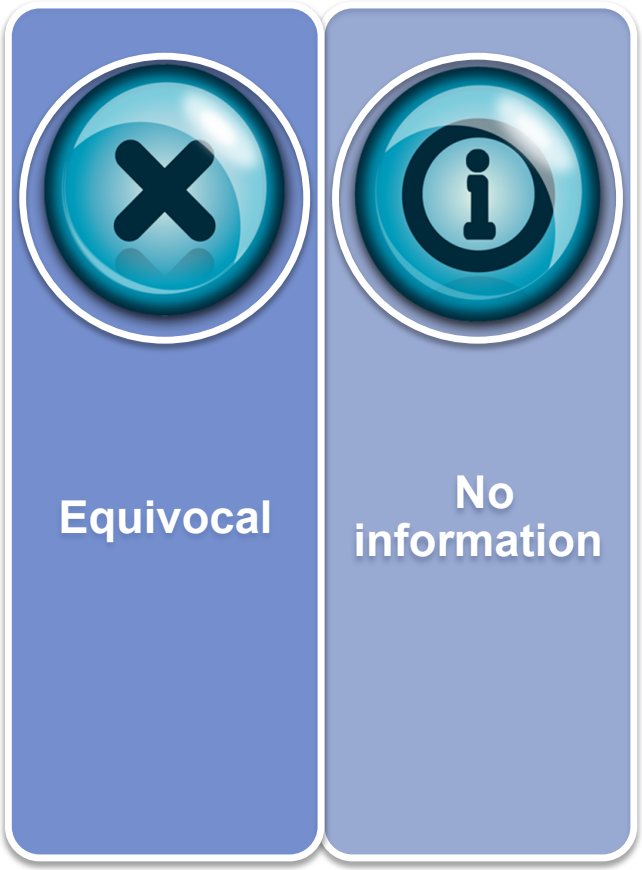
No published research on chest tubes and insertion site dressings

Two studies can guide practice

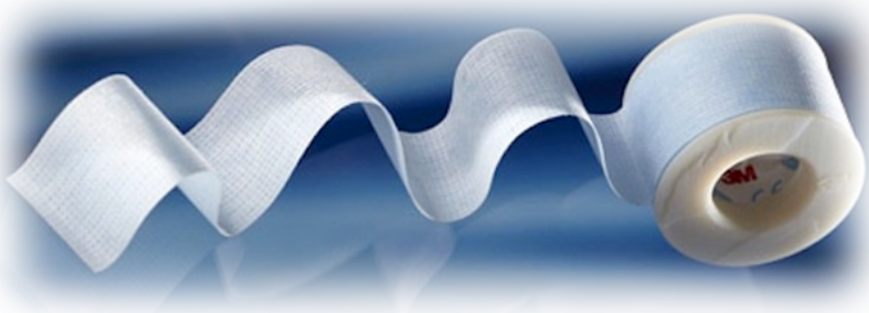
- Poster presentation at 2013 NTI[25]
  - Retrospective review of lung resection patients comparing dry sterile dressing alone to DSD + petroleum gauze
  - 4682 patients total, no difference in air leak or infection related to dressing
  - Petroleum gauze eliminated 2003
- Bench test of sutures[26]
  - Knots tied in various suture materials, each then wrapped in dry gauze, saline gauze and petroleum gauze
  - Knots exposed to petroleum failed at significantly higher rate



25. Jeffries, 26. Muffly

Research on sternotomy incision dressings[27-29]

- Do not routinely change dressing unless it is compromised or a change in the patient's condition requires assessment of the wound
- Use a dry, sterile dressing
- Secure the dressing with wide paper tape

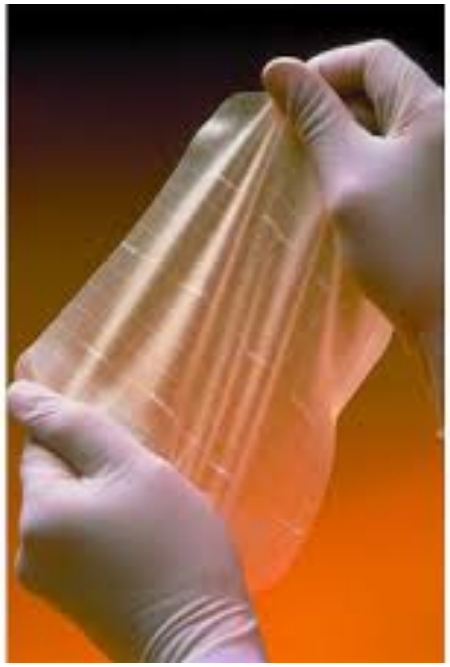


27. Wikblad, 28. Weber, 29. Wynne

British Thoracic Society Guidelines[30,31]

- Use “simple” dressing
- Dressing may stabilize drain but cannot take the place of suture
- Dressings that are too big or bulky can restrict chest movement and increase moisture retention
- Transparent dressings allow direct inspection of wound

May also secure tube to abdomen to relieve traction on chest tube site (theoretically similar to Foley catheter securing on inner thigh)



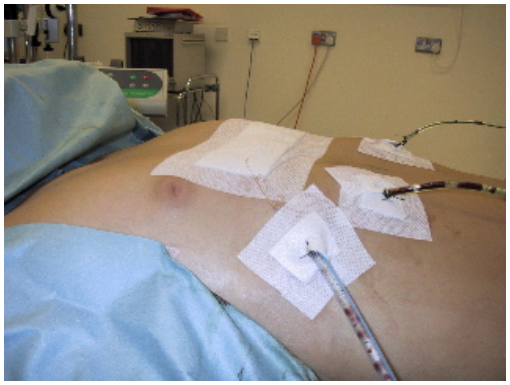
30. Hutton, 31.BTS

Research or Evidence?

As of yet, no peer reviewed **research** on chest tube dressings

But we can use nursing judgement and expert opinion to guide care through **evidence**

Evidence supports dry sterile dressing or transparent dressing – no petroleum gauze, change only when indicated, not on a schedule



Criteria for chest tube removal: Pleural

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Chest Tube Directly Related to LOS

- Being aggressive with tube removal reduces LOS and complications related to hospitalization
- Chest tube duration directly related to risk of hospital-acquired infection [32]
- Chest tube duration > 18d associated with higher ICU mortality and ICU LOS[33]

32. Oldfield, 33. Kao

Criteria for chest tube removal: Pleural

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Air Leak: No Clear Rules[34-36]

- Bubbling in water seal is not an absolute contraindication when patients are breathing spontaneously
- Mechanical ventilation alone is not an indication for a chest tube
- Review of studies of VATS for pleurodesis showed OK to remove on POD 2 and D/C POD 3

More important to make empiric decision based on individualized assessment

34. Gottgens, 35. Jiwani, 36. Tawil

Criteria for chest tube removal: Pleural

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Fluid Drainage: No Clear Rules Either[37-39]

- Range of drainage with successful removal 200 mL/d to 400 mL/d
- In pediatrics, 5 mL/kg/d
- One study: to fast track, tubes removed if drainage ≤ 500mL/24 h, 2.8% required subsequent treatment
- Chylothorax as complication of surgery: remove tube at 450mL/d once fluid is clear[39]

More important to make empiric decision based on individualized assessment

37. Hessami, 38. Grodzki, 39. Bryant

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Outpatient Chest Drainage[40-42]

Supported by research for pleural drainage

Prolonged Air Leak (PAL):

Instead of long, expensive LOS when only condition is air leak, outpatient chest drainage works

PAL initially > POD5, now described as: patient is ready to go home except for chest tube need

Continued Fluid Drainage

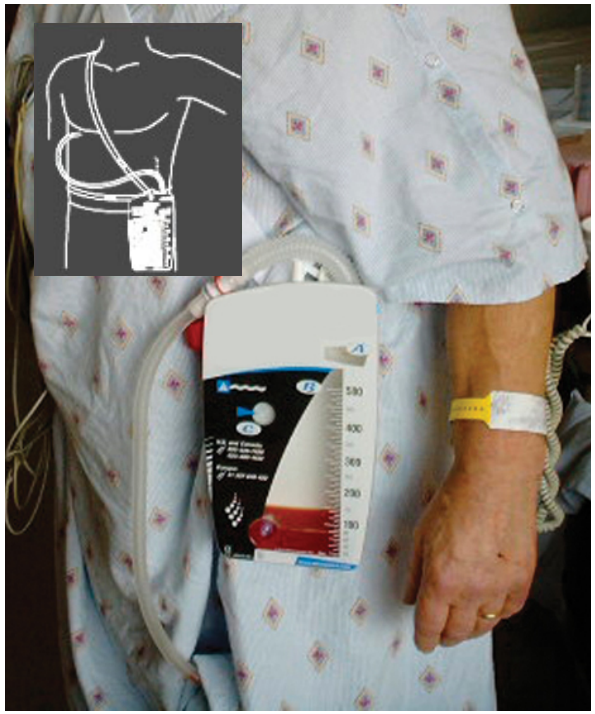
Postoperative or pleural effusion

40. Royer, 41.Rieger, 42. Southey

Outpatient Chest Drainage

Key is careful patient selection[40-42]

- Medically ready for discharge
- CXR findings stable, reviewed before discharge
- Patient alert and oriented
- Mobility independent or minimal assist
- Will not be home alone
- Pain controlled with PO meds
- Working telephone, able to call for assistance
- Home reasonably close to definitive medical care if needed
- Able to return for outpatient visits



40. Royer, 41. Rieger, 42. Southey

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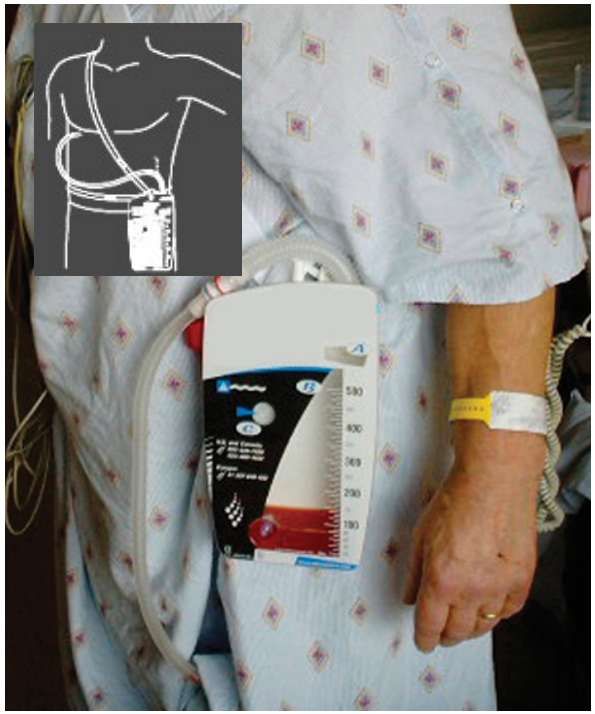
Outpatient Chest Drainage[40-42]

Financial

- Reduces LOS
- Opens beds for new patients, increasing surgery capacity
- Safe with rare readmission

Patient

- High patient satisfaction going home
- Less risk of exposure to nosocomial infection
- Reduces risks of immobility



40. Royer, 41. Rieger, 42. Southey

Criteria for chest tube removal: Mediastinal

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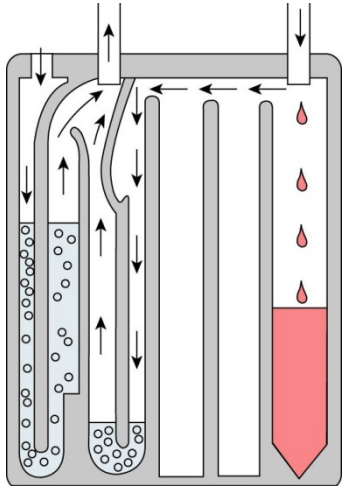
After cardiac surgery, thresholds variable[43,44]

- Statistically, by post-op hour 8, drainage averages 31mL/h
- Typically, patients are either bleeding or they are not bleeding
- Fluid volume recommendations average about 10 mL/h, but measured volume not usually key to decision-making



Most important controllable variable affecting post-op bleeding??[45]

The surgeon!

43. Abramov, 44. Gercekoglu, 45. Dixon

Criteria for chest tube removal: Pleural technique

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Unexpected Results

- Study of postop thoracotomy pts: Half removed at full inspiration, half at full exhalation[46]
- All did Valsalva
- 32% of full inspiration had new or larger PTX compared with 19% in exhalation group
- Only clinically significant in 5 patients (1.5%)
- Findings the opposite of what was expected

Recommend: Remove after full exhale

46. Cerfolio

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Evidence does not support routine post-removal imaging[47-49]

- After CABG: pleural or mediastinal
- After thoracic surgery: only if patient becomes symptomatic
- Validated in adults and peds/neonatal

Bedside ultrasound imaging is a reliable option if there are any questions about air in the pleural space

Treat the patient, not a picture of the patient

47. Sepehripour, 48. Reeb, 49. van den Bloom

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Unnecessary imaging not without risk[50]

- Displaced lines and tubes when moving patient
- Patient's discomfort
- "Routine" imaging often finds "abnormalities" not causing symptoms
- Clinicians are tempted to treat even when the patient's condition is unchanged

Financial cost of these issues are not available, but could be significant

"Oh, I hate it when that happens"

50. Ziegler

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2016 Published Survey of Chest Tube Management After Lobectomy[51]

- Most surgeons use one tube after VATS, two after open thoracotomy
  - Younger, academic, and high-volume surgeons use 1 tube regardless of type of surgery
- 70% of surgeons favor rigid tube, 28F
- Wide variation of fluid output acceptable for removal
  - Younger, academic and high-volume remove sooner with higher volume of drainage
- 55% get daily CXR

The surveyed surgeons "felt that clinical experience -- rather than the teaching they received…or published journal articles -- was the most important factor" that determines their CT management.

51. Kim

Financial benefits summary

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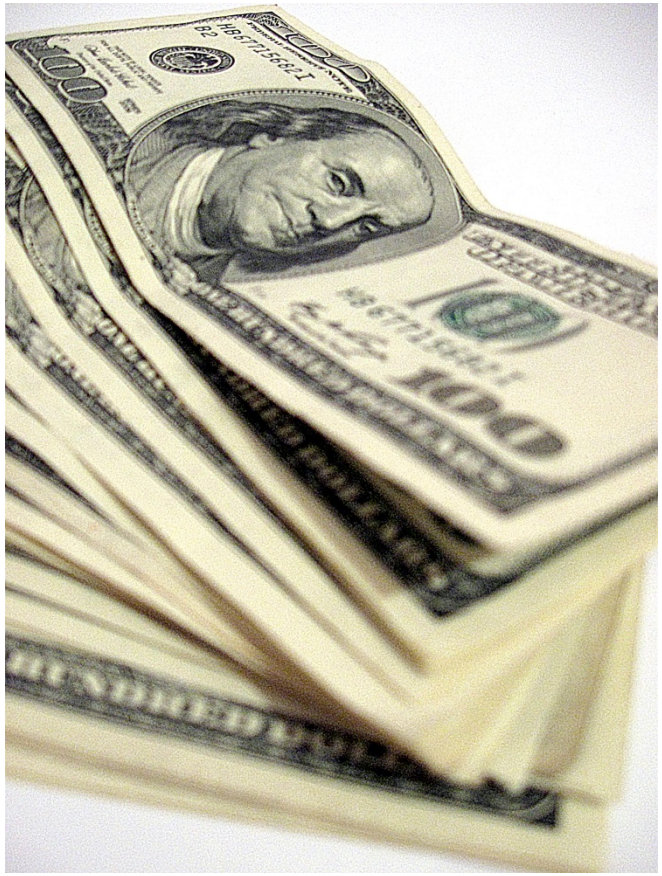
Financial benefit – cardiac

- Dressings/nursing care = $137.09
- Time associated with CXR x3 =$21.90
- Eliminate one CXR = $128

Total financial benefit realized in reduced costs of care per patient

$286.99



Note: details of financial analysis available at AtriumU.com

Financial benefits summary

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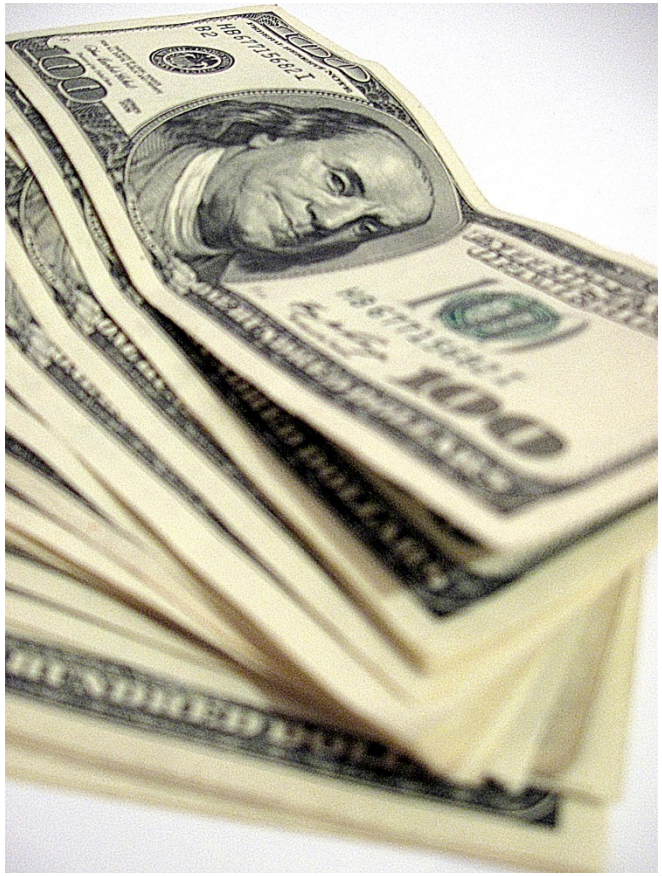
Financial benefit – thoracic

- Reduce LOS 1 day = $2090
- Reduce embolism precaution = $16.79
- Dressings/care $115.48
- Time associated with CXR x3 = $21.90
- Eliminate one CXR = $128

Total financial benefit realized in reduced costs of care per patient

$2372.17

Note: details of financial analysis available at AtriumU.com



If your hospital does 750 CABG per year and 750 thoracic surgery cases per year, your potential cost savings could be

CABG: **$215,242**

Thoracic: **$1,779,127.50**

Grand total: $1,994,370

Words of Wisdom

- Treat the patient, not an image
- Trust the body's healing power
- Trust your assessments and judgement as a professional registered critical care nurse
- Don't go looking for trouble – it will find you soon enough

Just because we've always done it… does not mean we should always continue to do it

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