Prehospital Lung Ultrasound

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Special Thanks:

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12% of medical 911 calls

60% diagnostic accuracy


Nitro
Albuterol
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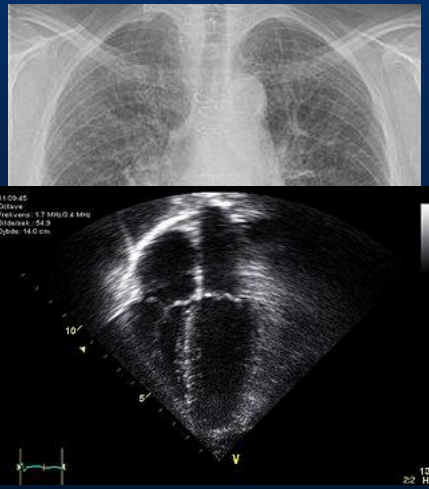

Why Does This Matter?

Cureus. 2022 Jun 12;14(6):e25866. doi: 10.7759/cureus.25866

Prehospital Diagnosis and Treatment of Patients With Acute Heart Failure

Michael Supples [1], Katelyn Jelden [1], Jenna Pallansch [1], Frances M Russell [1,✉]

Editors: Alexander Muacevic, John R Adler

Author information · Article notes · Copyright and License information

PMCID: PMC9275526 PMID: 35836447

Only 28% of CHF patients got NTG and 54% got bronchodilators

PLoS One. 2013 Oct 21;8(10):e78222. doi: 10.1371/journal.pone.0078222

Acute Decompensated Heart Failure Is Routinely Treated as a Cardiopulmonary Syndrome

Kumar Dharmarajan [1,2,*], Kelly M Strait [2], Tara Lagu [3,4,5], Peter K Lindenauer [3,4,5], Mary E Tinetti [6,7], Joanne Lynn [8], Shu-Xia Li [2], Harlan M Krumholz [2,9,10,11]

Editor: Sudhiranjan Gupta[12]

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PMCID: PMC3824040 PMID: 24250751

Half of inpatients receive acute respiratory treatment

Int J Cardiol. 2021 Dec 1:344:127-134. doi: 10.1016/j.ijcard.2021.09.031. Epub 2021 Sep 20.

Early intravenous nitroglycerin use in prehospital setting and in the emergency department to treat patients with acute heart failure: Insights from the EAHFE Spanish registry

Òscar Miró [1], Pere Llorens [2], Yonathan Freund [3], Beth Davison [4], Koji Takagi [4], Pablo Herrero-Puente [5], Javier Jacob [6], Francisco Javier Martín-Sánchez [7], Víctor Gil [8], Xavier Rosselló [9], Aitor Alquézar-Arbé [10], Francesc X Jiménez-Fábrega [11], Josep Masip [12], Alexandre Mebazaa [13], Gad Cotter [4]; EAHFE Research Group

Affiliations + expand

PMID: 34543690 DOI: 10.1016/j.ijcard.2021.09.031

Earlier treatment with nitroglycerin improved mortality

Lung Ultrasound Improves Diagnostic Accuracy

› Acad Emerg Med. 2024 Jan;31(1):42-48. doi: 10.1111/acem.14811. Epub 2023 Oct 19.

Prehospital lung ultrasound in acute heart failure: Impact on diagnosis and treatment

Frances M Russell [1], Michael Supples [2], Omkar Tamhankar [3], Mark Liao [1], Patrick Finnegan [1]

Affiliations + expand

PMID: 37772384 DOI: 10.1111/acem.14811

Pre-ultrasound: 23% sens, 97% spec for CHF
Post-ultrasound: 71% and 96%

› Scand J Trauma Resusc Emerg Med. 2016 Aug 2:24:96. doi: 10.1186/s13049-016-0288-2.

Prehospital lung ultrasound for the diagnosis of cardiogenic pulmonary oedema: a pilot study

Christian B Laursen [1 2], Anja Hänselmann [3], Stefan Posth [4 5], Søren Mikkelsen [4 6], Lars Videbæk [3], Henrik Berg [6]

Affiliations + expand

PMID: 27480128 PMCID: PMC4970268 DOI: 10.1186/s13049-016-0288-2

With ultrasound: 99.4% sens, 77.3% spec for CHF

Lung Ultrasound is Feasible

Meta-Analysis > Eur J Emerg Med. 2025 Apr 1;32(2):87-99.
doi: 10.1097/MEJ.0000000000001205. Epub 2024 Dec 3.

Contribution of point-of-care ultrasound in the prehospital management of patients with non-trauma acute dyspnea: a systematic review and meta-analysis

Omide Taheri [1 2 3], Julie Samain [1], Frédéric Mauny [2 3 4], Marc Puyraveau [2 3 4], Thibaut Desmettre [5], Tania Marx [1 2 3]

Affiliations + expand

PMID: 39630617 PMCID: PMC11855997 DOI: 10.1097/MEJ.0000000000001205

The evidence supports the use of POCUS for managing acute nontraumatic dyspnea in the prehospital setting in terms of feasibility, overall diagnostic contribution, and, particularly, lung ultrasound for acute heart failure diagnosis.

Meta-Analysis > Am J Emerg Med. 2024 Jun:80:91-98. doi: 10.1016/j.ajem.2024.03.021.
Epub 2024 Mar 18.

Diagnostic accuracy of prehospital lung ultrasound for acute decompensated heart failure: A systematic review and Meta-analysis

Frances M Russell [1], Nicholas E Harrison [2], Oliver Hobson [3], Nicholas Montelauro [4], Cecelia J Vetter [5], Daniel Brenner [2], Sarah Kennedy [2], Benton R Hunter [2]

Affiliations + expand

PMID: 38522242 DOI: 10.1016/j.ajem.2024.03.021

Similar diagnostic test characteristics for ADHF diagnosis in the prehospital setting as in the ED

Planned Study (NCT07549334)

Multicenter prospective nonrandomized study

Compares patients who received an ultrasound exam and those who did not

Outcomes: treatment given, diagnostic accuracy, ultrasound quality, patient outcomes

Study Leads:

Elizabeth Blizzard, Rutgers New Jersey Medical School

Andrew Grandin, ChristianaCare

Jesse Yuan, DO, Rutgers New Jersey Medical School

RUTGERS HEALTH
New Jersey Medical School
Department of Emergency Medicine

ChristianaCare™

Inclusion Criteria:

- Complaint of dyspnea
- At least one of the following:
- Oxygen saturation <94% on room air
- Abnormal lung sounds
- Increased work of breathing
- Pedal edema
- Orthopnea

Exclusion Criteria:

- Pediatric patients (<18)
- Traumatic etiology
- Cardiac arrest at any point prehospitally
- No ultrasound-trained paramedic involved in patient's care

Thank you! Questions?

tsatty@rutgers.edu

Upcoming Study Information:

eab318@njms.rutgers.edu
andrew@grandideas.org

Use the QR code to view the full literature review

Pre-Hospital IV Nitroglycerin: "Come with Me and E"SCAPE"

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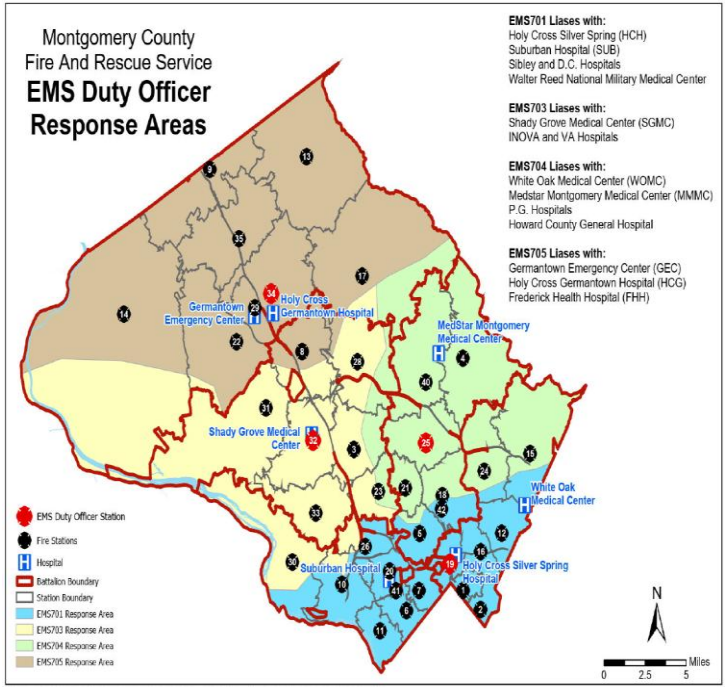
Assistant Chief, Emergency Medical & Integrated Health Section

The Current Challenge

- Heart Failure (HF) one of most debilitating dx
- Severe HF: 1M ED visits
  - 30% one-year mortality, 15% 30-day mortality
- **Huge** issue: Contributes to rates of PARCA (EMS Post arrival Respiratory or Cardiac Arrest)
- CPAP helps fix a result, not so much etiology (Sub-Lingual and Paste forms of NTG sub-optimal)
- Our needs analysis: ~130 patients/year



Source: Arrigo et al, 2020

SCAPE Patho Review

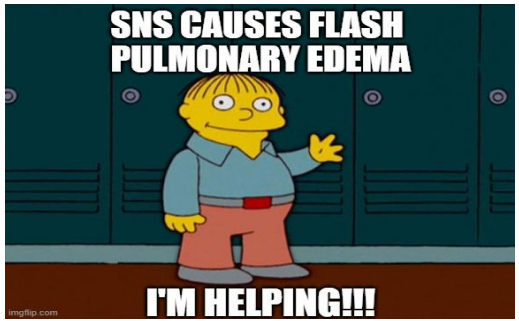
<u>Sympathetic Crashing Acute Pulmonary Edema</u> = SCAPE

- Acute severe hypertensive subset of HF: 10-20% of cases
- Over-activation of Renin/Aldosterone/Angiotension system
  - Chronic HTN ➔ Stiff blood vessels ➔Vasoconstriction, BP elevation
- Increased preload/afterload, vasopressin release

<u>Clinical Picture</u>

- Respiratory distress, extremely elevated BP, often SBP >200
- "Warm and wet", systemic volume overload may be absent

- Triggers: Chronic (HTN, CKD/missed dialysis), or missed meds, stress, exertion, sympathomimetics
- SNS and RAAS thinks it's helping, but overwhelms cardiac compensatory mechanisms



Source: Lahouti, 2021

Why IV NTG?

- NTG targets this hypertensive feedback loop (ie etiology)
- Reduces pre-load > afterload, allowing heart to clear fluid
- Rapid onset, short half-life (1-4 min), perfect for infusion or slow bolus therapy ➔ IV facilitates synergy between CPAP & NTG
- Hospital studies preceding EMS studies were convincing

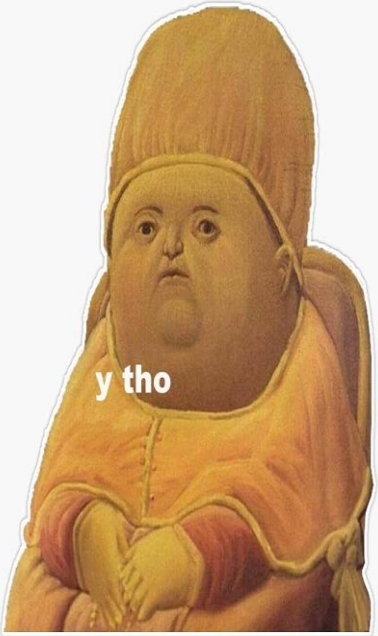
  Aggressive treatment ➔ Less ICU, LOS, lower mortality/morbidity, less ETI

Ann Emerg Med. **2007** Aug;50(2):144-52. Severe decompensated HF with high-dose IV NTG: a feasibility and outcome analysis.

- Prehospital literature limited but promising (feasible, safe, effective)

A Int J Cardiol. **2021** Dec 1;344:127-134 *EAHFE Group* Early IV NTG use in prehospital setting and in ED to treat patients with AHF

A Prehosp Emerg Care. **2020** Nov-Dec;24(6):844-850. Effectiveness and Safety of Prehospital IV Bolus Dose NTG in APE



We had introduced IV Pumps to our system in 2023

(For consistency, with added safety of presets)

Sources:; Miro et al., 2021; Patrick et al., 2020

MD IV Nitro Protocol For Severe CHF 2023

CANDIDATES/INDICATIONS

- Adult patients (over 18), rrespiratory distress/pulmonary edema, **SBP>150 or MAP>90mmHg**
- **AFTER** CPAP has been initiated

DOSE

- 400 mcg bolus, 40 mcg/min infusion (if pump available)
- Standing order, with notification required for inbound patients

- Note: State started very conservatively

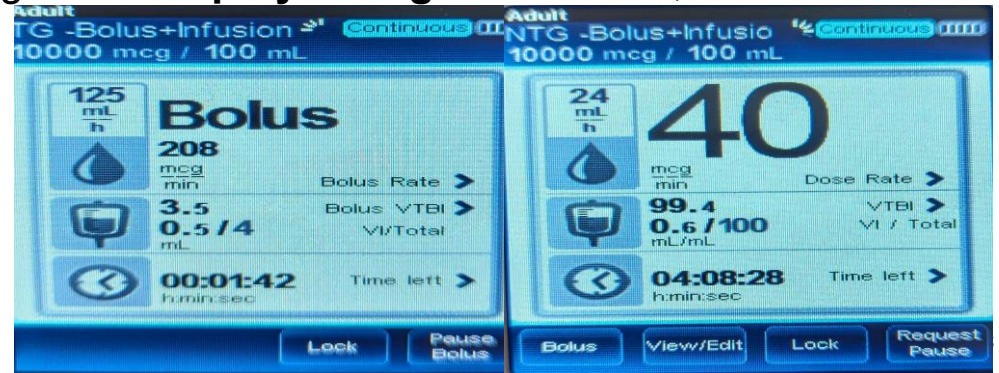
Source: Maryland Medical Protocols, 2023

MoCo: SCAPE Treatment Order & Titration

1. Make identification of SCAPE
2. Give 0.8 mg NTG SL **(state protocol)**
3. Apply CPAP
4. Obtain access IV/IO
5. Reconstitute 10 mg/**2 mL** into 100 mL bag
6. **Give only through IV pump** (MoCo) ➔ **No** NTG paste
7. Start continuous infusion at 40 mcg/min

New 2025 CPG: <u>60mcg for SBP>190</u>

8. Give 400 mcg bolus (**PRESET)**
9. Continue infusion at 40 mcg/min
10. After 5 min, repeat bolus if <u>no</u> improvement
11. Continue infusion at 40 mcg/min, **titrate up by 5 mcg/min** Q5 min, max 80



First Year of IV NTG

- Started November 2023
- 63 uses in one year
- Overall: 58% of patients 20% BP reduction
- SBP>190: 46% BP reduction of 20%

- ZERO cases of hypotension

- Outcome being collated but anecdotes of **patients looking so good** that Eds may:
  - Try to stop infusions
  - Try to take pts off CPAP

IV NTG to Date

Mean Initial BP	Mean Reduction1st to Last
189.1818182	24.6
Median Initial BP	Median Reduction Initial to Last
189	26
Mean Last BP	Mean Reduction High to Low
164.6	44.51
Median Last BP	Median Reduction High to Low
163	45
Mean High BP	20% Reduction 1st to Last
199.9545455	29.6%
Median High BP	20% Reduction High to Low
198	53.4%
Mean Low BP	% SBP <150
155.4204545	44.3%
Median Low BP	% Receiving Bolus
153	80.7%

N=106

Summary with Quick Pearl

- SCAPE patients benefit from aggressive treatment with IV NTG
- Targets etiology in Synergy w/ CPAP
- Safe, effective in many cases
- If no pumps, can STILL use IV bolus protocol

- Note IV NTG is beneficial and safe in pregnancy
- Incorporate treatment for eclampsia
  - Magnesium as indicated
  - Point ➔In this case, we **do <u>not</u> use labetolol**