

# EM Resident

The background of the cover is a photograph of a patient lying in a hospital bed, wearing a clear plastic ventilator mask. A white corrugated ventilator tube is connected to the mask. In the background, there are several medical monitors with glowing green and blue lights, typical of an emergency department or intensive care unit setting. The overall lighting is dim, with the primary light sources being the monitors and the ventilator's light.

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## Demystifying Ventilator Alarms

**GHB: Rise of a  
Forgotten Foe**

**A Bump in  
the Mumps**

**Hotspotting**

**Career Transitions**



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# Editor's Forum



## Priyanka Lauber, DO

Editor-in-Chief, *EM Resident*  
Lehigh Valley Health Network  
@PriyankaLauber

“Speaker, we have an election.”

These were the words that rang over the Representative Council in Denver, Colorado, in October as the EMRA Program Representatives chose their new Board of Directors. These representatives were impartial, often with no ties to the candidates, who judged candidates based on their curriculum vitae and their speeches alone. The practice of representatives voting in their Board rather than the current Board of Directors picking their new candidates is an intentional practice by EMRA. It’s an effort to remove personal preference or bias from the current standing Board and to encourage an ongoing and diverse representation that is more merit-based over nepotism.

This year the EMRA Program Representatives, who are an extension and represent residents across the United States, picked new Board members for the following positions:

- President-Elect
- Vice Speaker of the Council
- Secretary/Editor of *EM Resident*
- Director of Education
- Director of Technology

As a medical student trying to figure out which specialty appealed the most to me, I happened to stumble upon the Emergency Medicine Residents’

Association organization. I still vividly remember, as a second-year medical student, my attending gushing over EMRA and its resources being a benefit not only to medical students interested in emergency medicine, but also to medical students interested in *any* specialty. That was my hook into EM. It started with EMRA.

I began to learn more about the organization and was very impressed with its influence, resources, and efficiency. I could find no other resident group with the national stage and impact that EMRA seemed to possess, which it consistently used to empower residents and medical students. A resident-run organization that provided resources and benefits that were clear and tangible to everyone from pharmacists to medical students must be doing something right, I thought. And I knew one day I would like to be involved in this organization.

Fast forward to today: I am honored to have been elected as your Secretary/Editor, and it’s a privilege I do not take lightly. I am thankful for my predecessor, Dr. Tommy Eales, and the excellent staff who have continuously worked to change and improve this platform. We, as your Board of Directors, are here to serve you. We function to steward mission and resources, set strategy, provide oversight and governance to help EMRA grow and evolve as an organization.

One of the pillars *EM Resident* stands

on is its article submissions from medical students, residents, fellows, and attendings. We have always had so many valuable contributors who help advance our specialty’s collective knowledge. As a medical student, it is where I started my medical publications. **We are always looking for relevant content, so if you have ideas for publication or a compelling case you would like to share — email us at [emresidenteditor@emra.org](mailto:emresidenteditor@emra.org).**

When I ran for the Board, I ran on a platform to not only maintain our quality educational content of *EM Resident*, but to also increase collaboration across the United States for emergency medicine residents and medical students. I want us to have discussions about parental leave, pumping on shift for new mothers, leadership diversity issues in our residencies, work-place harassment, and much more.

I am very excited for the upcoming 2-year journey with the Board, growing as a leader, and helping increase our value to our members — who are the real reason EMRA is as strong as it currently stands.

If you have ideas in the avenues I have mentioned above, please email me anytime: [emresidenteditor@emra.org](mailto:emresidenteditor@emra.org).

Looking forward to the next 2 years with you all! And it’s my pleasure to introduce our new Board of Directors in the next few pages. ★





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# TABLE OF CONTENTS

- 4** Meet Your EMRA Leadership  
New EMRA Board
- 10** Demystifying Ventilator Alarms  
CRITICAL CARE
- 13** High Flow Nasal Cannula for the Emergency Physician  
AIRWAY
- 15** GHB: A Forgotten Foe Rises  
TOXICOLOGY
- 16** Forearm Strangulation  
ORTHOPEDICS
- 18** A Bump in Mumps  
INFECTIOUS DISEASE
- 20** Ultrasound Guided Erector Spinae Plane Block for Acute Management of Rib Fractures  
ULTRASOUND
- 22** Performance Enhancing Drugs  
SPORTS MEDICINE
- 25** Penile Mondor's Disease  
GENITOURINARY
- 26** Who Art Thou? Neck Swelling!  
CASE REPORT
- 27** Reflections on Innovation & Entrepreneurship in Emergency Medicine  
ADMIN & OPS
- 28** Hotspotting: Rethinking Health Care Delivery  
SOCIAL EM
- 30** Developing a Career in Clinical Informatics  
INFORMATICS
- 32** Making Sense of Graduate Medical Education Funding  
HEALTH POLICY
- 34** Beyond the Comfort Zone  
CAREER TRANSITIONS
- 36** Insights from ACEP/CORD Resident Teaching Fellowship  
MEDICAL EDUCATION
- 39** News & Notes  
CORD Academic Assembly, ERMA Awards, EMF Grants, Soundtrack of EM, Quiz Show, SmugMug and more
- 43** ECG Challenge  
INTERPRET AND DIAGNOSE
- 45** Board Review Questions  
PEER ASSISTANCE

## UPCOMING EVENTS

- |  |  |
|--|--|
| Dec. 31: Leadership Academy application deadline     | March 7: EMRA Spring Medical Student Forum               |
| Jan. 1: Quiz Show Team registration deadline         | March 7: EMRA Committee Events at CORD Academic Assembly |
| Jan. 1: EMRA Awards nomination deadline              | March 8: EMRA Quiz Show                                  |
| Jan. 24: Spring Resolutions deadline                 | March 8: Public Hearing & Resolution Review              |
| Feb. 26: NRMP Rank Order List certification deadline | March 9: Spring Rep Council Meeting                      |

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Emergency Medicine Residents' Association





The EMRA Representative Council elected the most diverse Board of Directors in the organization's 45-year history this fall, setting a new bar for inclusion in medicine.

# Meet Your EMRA Leadership

During the October RepCo meeting in Denver, program representatives elected 5 physicians and marked the passing of the gavel from **Immediate Past President Omar Maniya, MD, MBA**, to **President Hannah Hughes, MD, MBA**.

The elections reflect a wide diversity in gender, race, orientation, professional background, and practice goals. In that diversity there is strength, said EMRA Executive Director Cathey B. Wise, CAE.

"We want everyone to find a home in EMRA," Ms. Wise said. "Inclusiveness and diversity are also hallmarks of our new president's leadership. Dr. Hughes's commitment to diversity and inclusion will help ensure better discussions, fuller understanding of the issues our members face, and well-thought-out decisions that will lead to a stronger EMRA."

Newly elected board members include:

- **President-Elect RJ Sontag, MD**, of UT Health San Antonio;
- **Secretary/EM Resident Editor Priyanka Lauber, DO**, of Lehigh Valley Health Network;
- **Vice Speaker of the Council Tracy Marko, MD, PhD, MS**, of Health Partners Institute, Regions Hospital;
- **Director of Education Deena Khamees, MD**, of the University of Michigan;
- **Director of Technology Nicholas Salerno, MD**, of Louisiana State University (serving his second term on the EMRA Board).

Additionally, 2 EMRA Board members who were previously appointed are transitioning from a training phase into full-fledged representatives:

- **ACGME RC-EM Liaison Breanne Jaqua, DO, MPH**, of Mercy St. Vincent Medical Center;
- **EMRA Representative to the AMA Sophia Spadafore, MD**, of Mount Sinai School of Medicine — New York.

These new EMRA Board members join their colleagues:

- **Speaker of the Council Karina Sanchez, MD**, of Conemaugh Memorial Medical Center;
- **Resident Representative to ACEP Erik Blutinger, MD, MSc**, of The Mount Sinai Hospital;
- **Director of Health Policy Angela Cai, MD, MBA**, of Kings County Hospital/SUNY Downstate;
- **Director of Membership Greg Tanquary, DO, MBA**, of Doctors Hospital/Ohio Health;
- **Ex-Officio Member Venkat Subramaniam, MD**, of the University of Connecticut;
- **Medical Student Council Chair Corey McNeilly, MA**, of UT School of Medicine San Antonio.

Continue reading to learn more about your newest EMRA leaders, in their own words. ★





# Get to Know Your President Hannah Hughes, MD, MBA

University of Cincinnati • @hrh\_approved

## What are your 2 key goals as an EMRA board member?

I ran for EMRA President committed to do everything in my power to improve the diversity of our specialty in terms of gender, race/ethnicity, and orientation. While ambitious, this is desperately needed, as the rate of females entering emergency medicine declines and when less than 1% of emergency medicine leaders are underrepresented minorities. Diversity and inclusion has and will continue to be the main focus of my presidency.

## How will you support EMRA members — and how can they support the specialty?

We all have different backgrounds, perspectives, and niches — and we all have at least one thing in common. We picked the best specialty in the world! I'll support members by being available and staying true to our joint mission, to be "the voice of emergency medicine physicians-in-training and the future of our specialty." If you ever need anything, please reach out! Email: [president@emra.org](mailto:president@emra.org); Twitter: @hrh\_approved.

## Why is serving in a leadership role important to you?

Leadership isn't about title to me. It's about making meaningful change in relation to a problem that needs to be solved. We need leaders who are passionate, emphatic, and industrious — all of which were qualities I saw firsthand in EMRA leaders. I was inspired by the work that was being done by EMRA and wanted to be a part of it.

## What do you see as the biggest challenge for the specialty in the next 5 years?

Scope of practice in relation to the EM workforce will be our biggest challenge in the near future. The founders of our incredible specialty made huge strides in what it means to be an EM doc. (There are still plenty of attendings across the country who remember the days of not being able to push paralytics for airway management in the ED.) But our work is not done. As the future of EM, it's our job to ensure that the only path to independent practice of emergency medicine is being a residency trained, board certified physician.

## Reason you chose emergency medicine?

What other specialty can you simultaneously intubate an ACE-induced angioedema, push tPA, and massively transfuse a patient in hemorrhagic shock from a GI bleed — all irrespective of ability to pay, citizenship status, or demographics? The critical care and safety net aspects of emergency medicine are why I am proud to be an EM doc.

## Favorite procedure (to date)?

Emergent subclavian trauma line

## Most-used app on your phone?

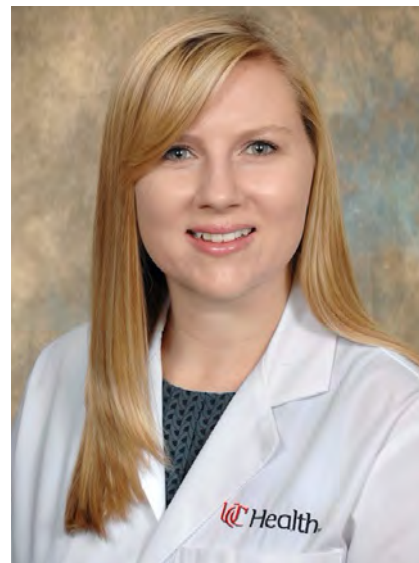
Slack, both for EMRA business and my residency's asynchronous learning, followed by MobilEM and Twitter.

## Beach or mountains?

Both? I spent my entire life in California until I left for residency, so I never had to choose. Within an hour and a half drive, I could be at either. There's something so peaceful about running on the beach, hearing the waves and looking at the seemingly endless ocean. But who could give up fresh snow and skiing?!

## Last song stuck in your head? "The Man" by Taylor Swift

What goes on pizza? Skip the pizza; let's get tacos! ★



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**Leadership isn't  
about a title to me.  
It's about making  
meaningful change  
in relation to a  
problem that needs  
to be solved.**

---



# EMRA's New Board

# Serve and Inspire

The Representative Council elected 5 new members to the EMRA Board of Directors. Meet your new directors!

President-Elect

## RJ Sontag, MD

UT Health San Antonio • @RJSontagMD

### What are your 2 key goals as an EMRA board member?

I plan to capitalize on my experience in politics and policy to be an advocate for our patients and our profession, and I will help empower others to become advocates.

### How will you support EMRA members — and how can they support the specialty?

Our 2 greatest resources are our massive, diverse membership and our powerful system of supporting their ideas. I will serve as a steward of our limited resources to ensure the projects we support provide the most possible benefits to our members, and I will challenge our members to find ways to improve our organization and our specialty through membership, service, and engagement.

### Why is serving in a leadership role important to you?

Residency is a perfect time to explore my leadership style and continue my advocacy work, and EMRA supports me on both fronts. I'm excited to leverage the power of our organization to improve the care of our patients, and I'm humbled by the opportunity to serve. I welcome the personal and professional development that comes with leadership.

### What do you see as the biggest challenge for the specialty in the next 5 years?

Finding a unified voice to advocate for our patients and profession remains our greatest challenge. So much more unites us than divides us, but without a concerted effort to harness our collective energy, we'll stagnate and risk being diminished.

### Reason you chose emergency medicine:

Emergency medicine is the only specialty that takes care of every patient, day or night, regardless of their ability to pay. That social justice mission is at the heart of why I chose this field and why I advocate for my patients.

### Favorite procedure (to date):

Direct laryngoscopy for intubation remains such a satisfying thrill, but I'm still hoping I get to relieve a tension pneumo with a needle some day!

### Most-used app:

Twitter. The bulk of people I follow are policy leaders, clinical gurus, and comedians. Oh! And drag queens. God bless the drag queen Twitter.

### Beach or mountains?

I reject the premise. I prefer exploring a new city.

### Last song stuck in your head:

Spice Girls, "Spice Up Your Life." It's my "walk up" song and always gets me pumped.

### What goes on pizza?

My favorite combo: pepperoni, sausage, and green peppers. **Fun fact:** I like anchovies too! ★



**Our 2 greatest resources are our massive, diverse membership and our powerful system of supporting their ideas. I'm excited to leverage the power of our organization to improve the care of our patients, and I'm humbled by the opportunity to serve.**

Secretary/*EM Resident* Editor  
**Priyanka Lauber, DO**

Lehigh Valley Health Network • Pennsylvania ACEP Board of Directors  
@PriyankaLauber

**What are your 2 key goals as an EMRA board member?**

1. Help make policy and achieve actionable items to improve residents' and medical students' lives in a tangible manner.
2. Encourage more diverse resident and med student involvement in EMRA leadership and membership.

**How will you support EMRA members — and how can they support the specialty?**

Support EMRA by creating *EM Resident* content that is helpful and educational.

**Why is serving in a leadership role important to you?**

EMRA is a fantastic organization that invests in its members and its leaders. Being involved in EMRA's leadership opens up a world of opportunities to grow and receive mentorship that will provide me the tools to become an effective and collaborative leader in the future.

**Reason you chose emergency medicine:**

Having the skills to help in any emergency medical situation. As a medical student, the EM physician felt like the epitome of a physician.

**Favorite procedure (to date):** Chest tubes all the way

**Most-used app:** Instagram

**Last song stuck in your head:** "Loyal" by Odesza ★



Vice Speaker of the Council  
**Tracy Marko, MD, PhD, MS**

Health Partners Institute/Regions Hospital  
@tracy\_marko



**What are your 2 key goals as an EMRA board member?**

One goal is to increase involvement in the Representative Council. I would like to hear from more residents, fellows, and medical students, so that EMRA can better serve all of its members. A second goal is to encourage and provide support for resident engagement in ACEP state chapters. This includes opportunities for participation at a state and federal level, such as involvement in ACEP council as alternate councilors.

**How will you support EMRA members — and how can they support the specialty?**

I will actively listen to the ideas, viewpoints, and feedback of EMRA members. I will also engage with residents, fellows, and medical students who want to be involved in shaping the future of emergency medicine, supporting them in their pursuit of personal professional goals. EMRA has a vast number of leadership roles and opportunities to develop skills and facilitate learning and advocacy experiences.

**Favorite procedure (to date):** Intubation!

**Most-used app on your phone:** Pandora — *Need to Breathe* station

**Last song stuck in your head:** "Look Up Child" — Lauren Daigle

**What goes on pizza?** "Everything" ... except pineapple and Canadian bacon ★



## Director of Technology

# Nicholas Salerno, MD

LSU's Spirit of Charity Emergency Medicine Residency • @nickrsalerno

### What are your 2 key goals as an EMRA board member?

**Goal #1:** To continue to build on the EMRA's new app platform, MobilEM, in effort to improve existing apps and digital clinical resources as well as collaborate with our members to create new ones. **Goal #2:** By accomplishing goal #1 and through other technology-related initiatives, I want have a role in making EMRA's apps the "go to" for on-shift emergency medicine clinical resources. By doing this, we have the opportunity to improve care for our patients.

### How will you support EMRA members — and how can they support the specialty?

I will always have an open ear. I intend to facilitate the will of our membership, and make sure that EMRA is the organization best serving their professional interests. Our members can support our specialty by getting involved and staying involved. Our medical student and resident membership groups are very strong. I'd really love to see EMRA grow its alumni membership and increase their involvement so we can find more ways to address the needs of our independently practicing members.

### Why is serving in a leadership role important to you?

Having a role in leadership is important to me because it ensures that I have "skin in the game" and makes me partially responsible for the future of my specialty. If there is something I don't like or there are unmet needs, I have the ability to step in and make things better.

**Most-used app on your phone:** MobilEM!!!

**Beach or mountains?** Beach

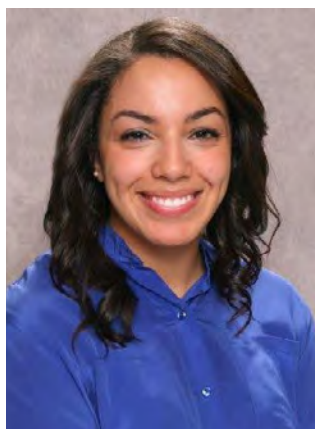
**Last song stuck in your head:** "Ghostbusters" (My 4-year-old found the Ghostbusters song on YouTube and has become addicted.)



## Director of Education

# Deena Khamees, MD

University of Michigan Medical Education Fellow  
Baylor College of Medicine EM Residency Alum • @\_deenden



### What are your 2 key goals as an EMRA board member?

My EMRA goal is to make learning fun again — how can we make medical school and residency a time of thriving and not just surviving? My personal goal is to create structured time management skills so that I can give my best to each of my commitments.

### Why is serving in a leadership role important to you?

Mom always said, "those who can, should." I see a need in our community and I believe in the path EMRA has created to meet those needs. I am excited to delve into the areas that need work, create opportunities for our rising leaders, and make our specialty the home our membership needs.

**Favorite procedure (to date):** Is it too cliché to say intubations? If so, I'll say that I really do love a good paracentesis — usually low risk, easy, and of huge, immediate benefit to patients!

**Most-used app:** EMRA Antibiotics Guide! Obsessed. After that, YNAB, which has been LIFE CHANGING for my ability to budget and feel financially secure! Also obsessed.

**Beach or mountains?** A cruel question! But like I tell my med students, I have to commit! Mountains.

**Last song stuck in your head:** "I'll Make a Man Out of You" from Mulan

**What goes on pizza?** Beef pepperoni (trust me), extra cheese, and mushrooms. I'm nervous someone is going to answer "pineapple" and I'll have to fight them! ★

ACGME RC-EM Liaison  
**Breanne Jaqua, DO, MPH**  
Mercy St. Vincent Medical Center • @BreanneJaqua

**What do you see as the biggest challenge for the specialty in the next 5 years?**

One of the biggest challenges for the specialty now and in the future is wellness and burnout. This has been a focus for me since 2015 when I assisted with the development of the Mental Health Awareness Task Force, an initiative of the Council of Osteopathic Student Government Presidents, a council of AACOM. Wellness remains a core interest of mine, and I look forward to presenting at the ACGME's Annual Educational Conference in February 2020 on "Diversity and Inclusion Training to Promote Wellness in Residency Programs."

**Why is serving in a leadership role important to you?**

I chose a career in medicine because I care deeply about doing meaningful work that improves the lives of others. Effective leadership accomplishes the same goal, therefore I invested significant time and energy to develop my leadership skills during medical school and now residency. When I first learned that I would be working with the EMRA Board of Directors as the liaison to the ACGME's Emergency Medicine Review Committee, I was overjoyed. I knew this was a unique chance for personal learning and growth, but more important, an exceptional opportunity to serve.

**What goes on pizza:** Extra cheese and pepperoni

**Last song stuck in head:** "Uprising" by Muse

**Beach or mountains:** Beach all the way! I grew up in Key West, Florida, so I am an island girl at heart. ★



EMRA Representative to the AMA  
**Sophia Spadafore, MD**  
Mount Sinai School of Medicine  
@sophiaspadafore



**What are your 2 key goals as an EMRA board member?**

To engage EMRA members interested in policy to become involved in the EMRA Representative Council and ACEP Council, and to mentor EMRA members who are interested in becoming active with the AMA.

**Why is serving in a leadership role important to you?**

When I was first beginning my journey in medicine I had no idea how to get involved with policy and advocacy work, and it was a few dedicated leaders showing me the way that allowed me to get where I am today. I want to now be the leader who finds those who have the drive and passion and show them how to move medicine in the right direction.

**Reason you chose emergency medicine:**

I love waking up every day not knowing what my day will be like. I love helping people in need every single day. I love not turning patients away because they have nowhere else to go. I love the support we give each other when we cannot save a patient, and the joy we share when we can. I love waking up every day knowing I get to work as an emergency physician.

**Favorite procedure (to date):** Intubation

**Most-used app on your phone:** MDCalc

**Beach or mountains?** Beach. Although I do love a good powder day.

**Last song stuck in your head:** "On My Own" from Les Miserables

**What goes on pizza?** Always cheese, sometimes sauce, usually garlic, vegetables by whim ★



# YOUR FIRST SHIFT IN THE UNIT

## Demystifying Ventilator Alarms

Marc Cassone, DO

Geisinger Medical Center

Anthony Cocciolone, DO

Geisinger Medical Center

Eric Melnychuk, DO

Critical Care/Emergency Medicine Attending  
Geisinger Medical Center

### Ventilators, Alarms, and You

You are caring for a patient who arrived in acute respiratory failure requiring rapid sequence intubation. Establishing the airway itself was not problematic and no airway abnormalities were seen during intubation. After stabilizing the patient, you step out of the room to tend to another ill patient.

Some time later, the nurse from your first patient notifies you that the ventilator alarms keep going off, and that respiratory therapy is busy caring for another critically ill patient. Being the centered and disciplined resident that you are, you step into the room to begin systematically evaluating the situation.

What is your first move?

The goal of this article will be to review the basic concepts of volume and pressure characteristics in mechanically ventilated patient so that you will be able to interpret variations that trigger alarms. After reviewing the fundamentals, the article will review common causes of triggered ventilator alarms and how to troubleshoot these issues.

### Interpreting the Pressure-Time Curve

While you may notice several waveforms on the ventilator, each with their own nuances, a fundamental understanding of the pressure-time curve is important for the emergency physician. Pressure is created when there is flow directed into a closed system, such as the lungs. Resistance is created in this system from the Endotracheal tube (ETT), the airway, the chest wall, and the lung itself. Generally, there are two pressures that we need to be familiar with to understand this.

**Ventilator alarms can be the first sign of an acute process and should be addressed immediately.**

**It's important to understand basic troubleshooting and move beyond DOPES when managing vent alarms.**

#### Peak Pressure (Ppeak):

This is the summation of pressure generated by the ventilator to overcome airway (ETT and bronchus) resistance and alveolar resistance to attain peak inspiratory flow and to deliver desired tidal volume.

Put simply, it is the amount of airway pressure delivered by the ventilator to initially overcome the resistance of the ETT, airway, and alveoli. As you may recall from your undergraduate physics courses, resistance to flow is inversely proportional to radius (see Poiseuille's Law). Peak pressure is graphed as a summation of both initial airway resistance and lung compliance. In general, an acceptable maximum Ppeak is 40 cmH<sub>2</sub>O.

#### Plateau Pressure (Pplat):

Plateau pressure is the pressure in the lung after a certain volume is delivered into the lungs. This is measured by doing an inspiratory hold, which effectively eliminates any airway resistance (when flow stops, resistive work is zero) from the equation. This is a gross reflection of lung compliance, or "stiffness." Given the absence of flow when measuring the plateau pressure, the main determinant of plateau pressure is compliance. This may be easier to understand if you think that they are inversely proportional: if lungs are very compliant or "stretchy" then the resultant plateau pressure reflected will be lower. The opposite is true of stiff lungs, or low compliance.

So what is compliance really?

Compliance is simply the change in volume divided by the change in pressure; if you have a large change in volume with low-pressure change, compliance will be high. Compliance plays a role in both calculating Ppeak and Pplat. In general, an acceptable maximum Pplat is 30 cmH<sub>2</sub>O. Changes in airway resistance and compliance can affect the pressure-time curve.

### Troubleshooting Alarm Types: Moving Beyond DOPES

During ventilator troubleshooting, many residents are taught the DOPES mnemonic: check for Dislodgement, Obstruction of the ETT from mucus plugs or from patients biting on the tube, Pneumothorax, Equipment malfunction, and Stacked Breaths or patient ventilator dyssynchrony. The goal of this section is to move beyond DOPES and thereby gain an understanding of the different alarm types, their associated waveforms, and the etiologies triggering the alarms. While different ventilators will use different displays or alarm configurations, the below concepts hold true regardless of model.

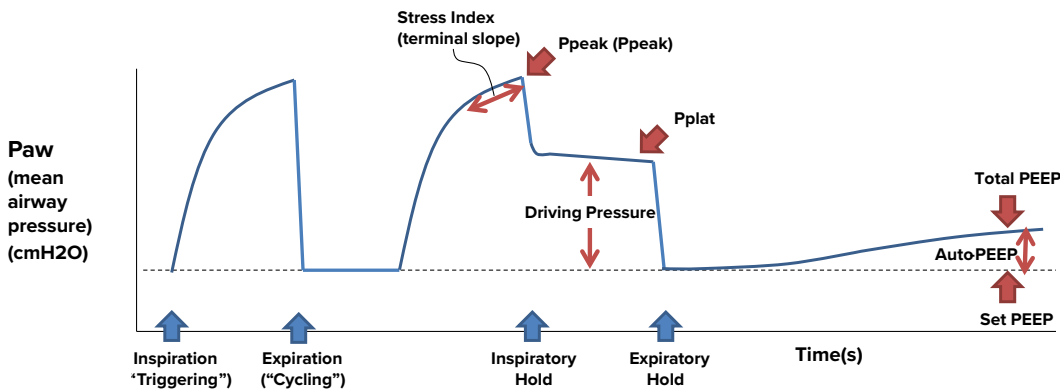
#### 1. Low Peak Pressure: Think Air Leak

The ventilator alarm is alerting you to "low peak pressure" (or simply "low pressure"). There is a leak in the system and the ventilator is not able to generate the peak or plateau pressure necessary to oxygenate or ventilate the patient.

*ETT Position Too High:* Check ETT depth: is it in the same position as during initial intubation? Dislodged during

# RESPIRATORY MECHANICS

## Pressure-Time Curve



**Compliance (C<sub>RS</sub>) = ΔV / ΔP**

Static C<sub>RS</sub> = Tidal Volume (V<sub>T</sub>) / (P<sub>plat</sub> – Positive end-expiratory pressure [PEEP])

Dynamic C<sub>RS</sub> = V<sub>T</sub> / (Peak inspiratory pressure [PIP] – PEEP)

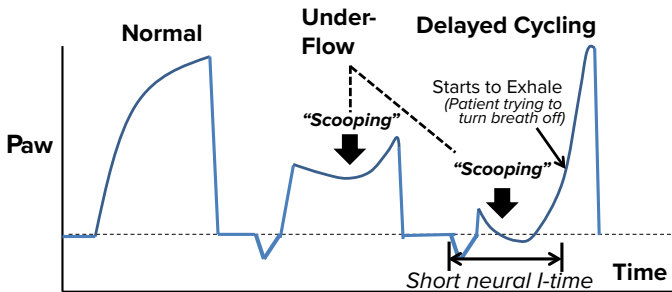
\*Normal static C<sub>RS</sub> 50-100 mL/cmH<sub>2</sub>O on ventilator

**Resistance (R) = ΔP/flow**

Resistance = (PIP – P<sub>plat</sub>)/flow

\*normal R <10 cmH<sub>2</sub>O/L/s

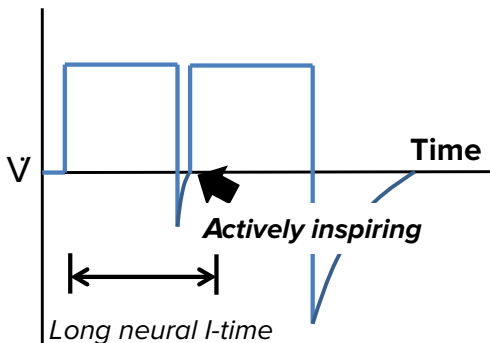
## PATTERNS OF VENTILATOR DYSSYNCHRONY



Try:

- Increase flow rate
- Decrease I-time
- Increase analgesia/sedation +/- paralyze if ARDS or asthma
- Switch to PC or PSV if higher V<sub>T</sub> are safe

## Double Triggering, Early Cycling, “Breath Stacking”



Try:

- Increase flow rate
- Increase I-time
- Add short end-inspiratory pause
- Increase V<sub>T</sub> if safe
- Switch to PSV if longer breath, higher V<sub>T</sub> is safe

transport? Consider repeating a chest x-ray.

**ETT Cuff Leak:** Some ventilators will show and adjust cuff pressure on the monitor. Cuff pressure may need to be increased or the entire ETT replaced. Also consider a leak in the ETT and ventilator interface as well as the tubing connecting the ventilator to the ETT.

**Chest Tube Leak:** Confirm distal chest tube holes are in the pleural space and that there are no leaks in the tubing or connections. Consider repeating a chest x-ray and advancing the tube as needed.

**Bronchopulmonary Fistula:** Rare cause but consider in patients with a history of tuberculosis, radiation therapy, chemotherapy, or who have undergone lung resections. This etiology is ultimately diagnosed via bronchoscopy.

### 2. High Peak Pressure, Normal Plateau Pressure: Think Resistance

The ventilator is showing isolated high peak pressures. There is resistance in the ETT or distal bronchus causing a smaller diameter and requiring the ventilator to increase pressure in order to deliver the same breath. When taken

off the ventilator, these patients will have increased resistance with manual ventilation.

**Bronchospasm:** Does the patient's history or exam indicate reactive airway disease or anaphylaxis? Consider a trial of bronchodilators, steroids or epinephrine.

**Obstruction in the ETT:** Consider a mucous plug (improved with frequent Chest PT, in-line suctioning, bronchoscopy), aspiration event (is the ETT cuff pressure adequate?), hemoptysis (traumatic from ETT placement?), or possible water or condensation in ventilator circuit or the heat exchanger.

**Kink in the Circuit:** Consider ventilator tubing kink or is the patient biting the tube?

Consider bite block and proper sedation and analgesia.

**ETT size:** Is this the right size ETT for your patient? This can often be an issue in pediatrics.

### 3. High Peak Pressure, High Plateau Pressure: Think Compliance

The ventilator is showing high peak and plateau pressures. There is an issue with the compliance of the lungs requiring the ventilator to increase the pressure delivered. These are the most common types of ventilator alarms.

**Evolving Pneumonia:** Consider Ventilator-Associated Pneumonia; this can be indicated by a new-onset increase in FiO<sub>2</sub> or PEEP requirement. Repeat a chest x-ray or look for increase in sputum, fevers, or leukocytosis.

**Pulmonary Edema:** Can be caused by congestive heart failure, ARDS, increased overall volume status, or sudden



# CRITICAL CARE

catecholamine-release (“Flash Pulmonary Edema”). Consider diuretics, condensing IV fluids given, and adjusting PEEP.

**Auto-PEEP:** Caused by breath stacking in patient with progressively increasing PEEP and often seen in patients with obstructive sleep apnea, COPD, and reactive airway diseases. This may be caused by inappropriate PEEP levels, tidal volumes, or ventilator dyssynchrony (consider sedation/analgesia). This can be immediately improved by removing patient from the ventilator and manual ventilation. Left unchecked, this can cause hypotension and barotrauma. Consider adjusting the respiratory rate, tidal volume and/or inspiratory/expiratory ratio.

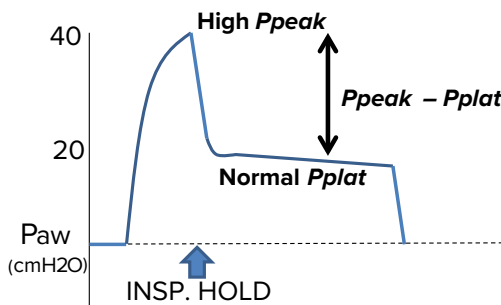
**Right Mainstem Intubation:** Check ETT depth, bilateral breath sounds, chest x-ray and adjust accordingly. **Tension Pneumothorax:** Can be caused by barotrauma or volutrauma. Watch for hypotension and consider immediately disconnecting the patient from the ventilator and emergent decompression with thoracostomy. Positive pressure ventilation may exacerbate a previously unnoticed pleural leak.

**Miscellaneous:** Once the above causes have been ruled out, consider other causes such as atelectasis, pulmonary fibrosis, abdominal distension (ileus, diaphragm injury), or circumferential burns.

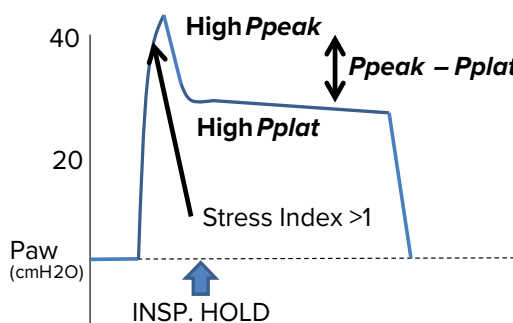
## 4. Hypoxia without Change in Ventilator Curve: Think Shunt

This is generally caused by dead-space ventilation or poor perfusion. Consider an intracardiac shunt (i.e. PFO), pulmonary embolism, AV-fistula, hypovolemia, and shock states. \*

## ALARMS, AGITATION, & ASYNCHRONY

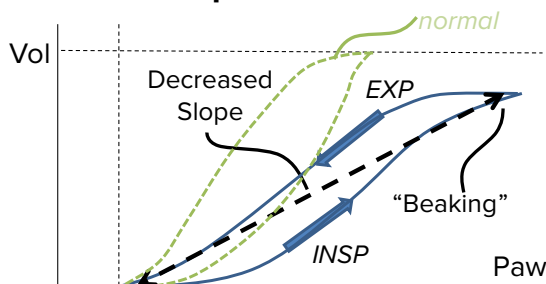


- $P_{peak} - P_{plat} > 10 =$  RESISTANCE PROBLEM**
- Small ET tube
  - Kinking/biting/obstructed ET tube
  - High flow rate or  $V_T$
  - Ventilator asynchrony
  - Mucus plug, blood clot
  - Bronchospasm



- $P_{peak} - P_{plat} < 10 =$  COMPLIANCE PROBLEM**
- ARDS, edema, atelectasis
  - Pneumothorax, effusion
  - Air trapping (Auto PEEP)
  - R mainstem intubation
  - Fibrosis, ILDs
  - Obesity
  - Abd compartment synd.

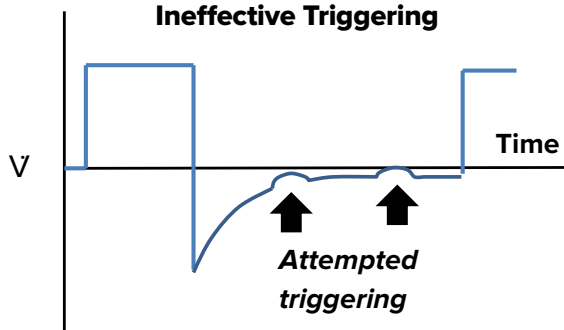
### Compliance Problem



### TAKE-HOME POINTS

- Ventilator alarms are a common occurrence both in post-intubation and chronic ICU patients. Alarms can be the first sign of an acute process and should be addressed immediately.
- Assessment of the Pressure-Time Curve, Ppeak, and Pplateau will help differentiate different causes of ventilator alarms. Physical exam findings, checking ETT placement, and repeating a chest x-ray can also be key to diagnosing causes. When initially unsure, refer to the DOPES mnemonic.
- When in doubt, take the patient off the ventilator and manually ventilate. If the patient gets better, it's likely the ventilator, the interface, or the settings. If the patient does not get better, consider an issue with the patient or with the ETT.

### Ineffective Triggering



Try:

- Increase PEEP in asthma and COPD
- Increase trigger sensitivity
- Switch from flow trigger to pressure trigger
- Relieve obstruction (mucous plug, kinked ET tube)

For more images and information, please refer to the EMRA Ventilator Management Card found in your EMRA member kit, or access the free version in MobileEM, available in iTunes and Google Play. For direct links to MobileEM, visit [emra.org/apps](http://emra.org/apps).



# High Flow Nasal Cannula for the Emergency Physician

**Jason Block, MD**

Emergency Medicine/Critical Care Fellow  
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## Background

**A**cute hypoxic respiratory failure can be imminently life-threatening. Administering supplemental oxygen to allow treatment of the underlying etiology of respiratory failure is the remedy. An emerging delivery method for supplemental oxygen is high-flow nasal cannula (HFNC). HFNC was patented in 1988 to prevent exercise-induced pulmonary hemorrhage in race horses. Humidified air was delivered at between 60 L/min to 500 L/min to “condition” their pulmonary and cardiovascular systems.<sup>1</sup> HFNC was introduced for humans in the mid-1990s and many subsequent studies have demonstrated convincing evidence for the utility of HFNC as an adjunct therapy for respiratory failure.

## Clinical Benefits

There are many benefits to administering supplemental oxygen via HFNC. Normal minute ventilation in a

70-kg person is approximately 6 L/min. When a patient is in respiratory distress, however, demand can be between 30-120 L/min.<sup>2</sup> Matching this demand with supplemental flow can decrease work of breathing and the sensation of dyspnea. High flow rates have also been shown to decrease anatomic dead space in the nasopharynx and therefore increase oxygen delivery and decrease CO<sub>2</sub> rebreathing.<sup>3</sup> There may also be some generation of positive pressure. Corely et al. compared pharyngeal pressures with low-flow nasal cannula and HFNC and demonstrated increased mean airway pressure by 3 cm H<sub>2</sub>O.<sup>4</sup> Similarly, Ritchie et al. demonstrated that pharyngeal pressures are proportional to flow, with approximately 5 cm H<sub>2</sub>O generated at a flow rate of 50 L/min by HFNC.<sup>5</sup> In contrast to noninvasive positive pressure ventilation (NIPPV), HFNC allows for expectoration by warming and humidifying mucus. Finally, numerous studies have demonstrated that patients are much more comfortable

with the small nasal prongs of HFNC as compared to NIPPV masks.<sup>6-9</sup>

## Hypoxemic Respiratory Failure

In pure hypoxemic respiratory failure, HFNC can improve dyspnea, decrease respiratory rates, and increase oxygen saturation and PaO<sub>2</sub>.<sup>7-9</sup> The landmark FLORALI trial published in *New England Journal of Medicine* in 2015 randomized approximately 310 hypoxemic patients to HFNC, NIPPV, or nonbreather in European ICUs.<sup>10</sup> The primary outcome, regarding the proportion of patients who were intubated, was no different between groups. Yet, there were lower rates of intubation in a subset of patients with severe hypoxemia, defined as PaO<sub>2</sub>:FiO<sub>2</sub> ≤ 200 mmHg. Also, the secondary outcome demonstrated lower all-cause mortality and more ventilator free days in the HFNC group. These results were echoed by a systematic review and meta-analysis published in *Chest* in 2017, which included studies that randomized patients with hypoxemic respiratory failure to HFNC, NIPPV or



conventional oxygen therapy. Overall, in this systematic review, there were lower rates of intubation and a strong, but non-significant, trend towards decreased mortality.<sup>11</sup>

## Cardiogenic Pulmonary Edema

HFNC has also been investigated in the setting of cardiogenic pulmonary edema, where NIPPV has already proven to decrease the need for intubation and decrease mortality.<sup>12</sup> In the *Annals of Emergency Medicine* in 2017, HFNC was better than conventional oxygen therapy, but the study excluded patients who needed NIPPV or intubation or who had oxygen saturations less than 90%.<sup>6</sup> HFNC may provide a very small amount of positive pressure, but its use in cardiogenic pulmonary edema should be limited to use in patients who have contraindications to NIPPV, do not tolerate NIPPV or have advanced directives precluding intubation.

## Hypercapnic Respiratory Failure

Similar to cardiogenic pulmonary edema, the use of NIPPV in hypercapnic respiratory failure has demonstrated reduction in intubation and mortality in COPD with a relative risk of 0.42 and 0.41, respectively.<sup>13</sup> One may be reluctant to use HFNC in patients with acute on chronic hypercapnic respiratory failure due to diminished respiratory drive with hyperoxia, but there are theoretical benefits to HFNC. These may include humidified air to loosen secretions, relief of bronchospasm with warm air, and increased flow to match patient's demand. There only exists case report evidence where venous pCO<sub>2</sub> levels have normalized with HFNC in addition to standard medical management.<sup>14</sup> One must exert extreme caution using HFNC in pure hypercapnic respiratory failure, but as in cardiogenic pulmonary edema, it may be utilized if intubation and NIPPV are non-options.

## Apneic- and Pre-oxygenation

HFNC has also been evaluated as a tool for preoxygenation and apneic oxygenation. Preoxygenation markedly prolongs time to desaturation.<sup>15</sup> A large meta-analysis including over 1800

patients showed that apneic oxygenation through a variety of methods, including HFNC, may decrease hypoxemia, improve first pass success, and increase the nadir peri-intubation oxygen saturation.<sup>16</sup> Included in this meta-analysis was the THRIVE technique, which originally evaluated HFNC use in the operating room for 25 patients with anticipated difficult airways. Of the 25 patients who were included, 12 were obese and 9 were stridorous. They were able to achieve a median apnea time of 15 minutes with no desaturations <90%. Two patients had HFNC used for the duration of the procedure, with apnea times of 32 and 65 minutes.<sup>17</sup> A study of apneic oxygenation for patients undergoing endotracheal intubation in the ICU compared 3 minutes of non-rebreather and a pharyngeal oxygen delivery catheter to HFNC delivering 100% oxygen at 60 L/min and found that median lowest oxygen saturation during intubation in the HFNC group was 100%, compared to 94% in the non-rebreather group. The odds ratio for severe hypoxemia was 0.14, favoring the HFNC group.<sup>18</sup> The PREOXYFLOW study randomized 124 patients undergoing intubation in 6 French ICUs to high flow face mask preoxygenation or HFNC preoxygenation and apneic oxygenation. They found no difference in lowest oxygen saturation or mortality.<sup>19</sup> This study is more consistent with the FELLOW and ENDAO studies, which have called into question the utility of apneic oxygenation altogether.<sup>20-21</sup> While the data regarding apneic oxygenation is heterogeneous, it may be beneficial for a patient already on HFNC to remain on HFNC during endotracheal intubation.

## Practical Considerations in the ED

Respiratory therapists are well-versed in the use of HFNC. Be considerate of the time and work involved in setting up the HFNC circuit, which is institution dependent, but generally takes 10-15 minutes to retrieve and set up. HFNC has two parameters to be set by the provider—flow rate and FiO<sub>2</sub>. A rule-of-thumb is to set the flow

rate around 20-30 L/min and titrate the flow to the patient's respiratory rate and work of breathing. Most HFNC circuits can deliver a maximum of 60 L/min. FiO<sub>2</sub> will then be titrated to the desired oxygen saturation. The provider can consider de-escalating to conventional oxygen therapy when the patient's work of breathing and oxygen saturation are acceptable on 20 L/min and 50% FiO<sub>2</sub>.

## Pitfalls

HFNC may be harmful if the need for intubation was merely delayed by its use. In 2015, Kang et al. in *Intensive Care Medicine* retrospectively evaluated mortality and outcome of patients receiving HFNC admitted to the ICU. Out of the 616 patients who received HFNC, 349 improved and did not require intubation. Of the 267 patients who did not improve, 175 required intubation. Patients who were intubated more than 48 hours after initiation of HFNC were nearly 28% more likely to die despite having similar illness severity and etiology of respiratory failure to the early intubation group.<sup>22</sup> While the majority of the patients improved without mechanical ventilation, this study suggests that if the trajectory of respiratory failure is toward mechanical ventilation, it may be harmful to further delay intubation.

## Summary

Emergency physicians should be familiar with the benefits and pitfalls of HFNC. HFNC is well tolerated by patients, and its use contributes to superior outcomes for patients with pure hypoxemic respiratory failure. It may be useful in cardiogenic pulmonary edema and hypercapnic respiratory failure, but NIPPV should be the first line therapy in those disease processes. If you are concerned patients will need mechanical ventilation to support them through their illness, do not delay intubation with NIPPV or HFNC. If the patient's trajectory is toward intubation, HFNC can facilitate preoxygenation and apneic oxygenation as well or better than standard measures. ★



# GHB

## A Forgotten Foe Rises

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Class of 2021

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**G**amma-hydroxybutyrate (GHB) is a central nervous system depressant that emerged in the 1990s as a popular “date-rape” drug.<sup>1</sup> In response to the drug’s high potential for abuse, it has been classified as a schedule I controlled substance in the United States.<sup>2</sup> On the street, slang for GHB includes G, fantasy, grievous bodily harm, juice, liquid ecstasy, liquid E, Georgia Home Boy, scoop, and many others.

### Mechanism of Action

GHB is a central nervous system depressant that interferes with GABA transmission by binding to and activating GABA-B receptors in the brain. Upregulation of GABAergic tone is responsible for GHB’s sedative properties.

### How is GHB Used in Society?

A recent story out of France brought the seemingly forgotten date-rape drug back into the limelight, citing rising recreational use that resulted in 10 drug-induced comas and 1 death.<sup>3</sup> A once popular component of dietary supplements used by bodybuilders to increase gains, the drug soon became known for the euphoria, altered sensorium, and enhanced sexual drive associated with its use.<sup>4</sup> As a result, GHB gained traction among ravers, partygoers, and nightclubs. The most common method of ingestion is consumption in a liquid.

Outside the realm of recreational use, GHB has been used to treat cataplexy and alcohol withdrawal syndrome. A 2007 study showed that those who received a combination therapy of GHB and naltrexone were better at maintaining abstinence than those who received either treatment modality alone.<sup>5</sup> As a

result GHB is now registered as Alcover in Europe and used to alleviate alcohol withdrawal symptoms and maintain abstinence during detoxification.<sup>6</sup>

### What is the Clinical Presentation of Acute GHB Toxicity?

Exposures to GHB range from mild to life-threatening depending on the dose and individual tolerance. GHB is rapidly absorbed with an onset of action 15-30 minutes post-ingestion, in addition to a short half-life of 30-50 minutes leading to its desirable quick and short effects.<sup>1</sup>

These pharmacokinetics paint the classic story of GHB intoxication you may see in your ED — “you are about to intubate a comatose patient and they wake up suddenly.” Case studies of acute GHB toxicity in the emergency department found that nausea, bradycardia, and decreased consciousness were the most common presenting symptoms.<sup>7,8</sup>

While euphoria, happiness, and increased sexuality are most commonly reported by users, the narrow therapeutic window of GHB makes more dangerous outcomes possible with even a small increase in dose.<sup>1,5</sup> For example, an increase in dose from 3-4 grams taken orally can be the difference between

successful treatment of alcohol withdrawal symptoms and loss of consciousness.<sup>9</sup>

GHB overdose has been associated with ataxia, seizures, respiratory depression, altered consciousness, and/or coma.<sup>1,5,10</sup> The majority of those presenting after acute intoxication were discharged within 6 hours, although intubation and hospital admission and treatment has been reported (intubation rates varied from 10-57% among different studies).<sup>1,9,11</sup> Co-ingestion with alcohol, amphetamines, and other illicit drugs is common and should be considered in the setting of GHB overdose.<sup>8,12</sup> In one study, coingestion with alcohol resulted in more frequent episodes of hypotension, oxygen desaturation, and vomiting.<sup>13</sup>

### What is the Treatment?

There is currently no accepted treatment modality for the reversal of acute GHB intoxication. Treatment is centered around supportive care with close monitoring of vital signs as well as cardiovascular and respiratory symptoms. Physicians should be prepared to intubate, although spontaneous recovery typically occurs within 5 hours of ingestion.<sup>8</sup> ★

### TAKE-HOME POINTS

1. The most common presenting symptoms of acute GHB toxicity are nausea, bradycardia and decreased consciousness
2. Due to GHB’s narrow therapeutic index and potential for severe central nervous system and respiratory depression, be prepared to intubate
3. Coingestion with alcohol and/or other illicit drugs is common, keep this in mind in the significantly altered or hypotensive patient
4. There is no definitive treatment for the reversal of acute GHB intoxication. Supportive care and monitoring for cardiovascular and respiratory symptoms are appropriate.



# FOREARM STRANGULATION

## *An Interesting Cause of Compartment Syndrome*

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A healthy 29-year-old male presented to the ED complaining of right forearm pain and swelling after a strangulation-type injury that occurred 5 hours prior to arrival. While water skiing, there was a miscommunication between him and the operator of his boat, leading to the boat accelerating at full speed while a rope was wrapped around his forearm. The patient was yanked forward but was able to untangle his arm after approximately 20 seconds. He immediately presented to an outside ED, where a forearm x-ray performed showed no fracture. However, during his stay at that hospital he required numerous doses of narcotic pain medication to achieve analgesia. He was subsequently discharged home with ibuprofen.

After worsening pain, the patient presented to a tertiary care facility near his home. He was subsequently admitted to the orthopedic surgery service for observation and pain control, with plans to discharge in the morning if he felt better. Unfortunately for the patient, he awoke the next morning with worsening pain, swelling, and decreased function of his right hand. The decision was made to take him emergently to the OR, and extensive forearm fasciotomies were performed. Intraoperatively, he was found to have significant hematoma and injury throughout the volar compartment, leading to compartment syndrome. The patient tolerated the procedure well and was discharged home the next day.



As seen in community ED



One week post-op

TABLE 1. 5 Ps of Compartment Syndrome

Early Findings	Paresthesias	Loss of 2 point discrimination and vibratory sensations
	Pain	On Passive Stretch or out of proportion to physical exam findings
	Pulse Deficit	Often absent early on. Presents when arterial compression and venous obstruction are present
	Pallor	Later finding. Poor Prognostic indicator
Late Findings	Paralysis	If greater than 6 hours after symptoms onset, can be permanent

### Discussion

Orthopedic complaints account for a significant percentage of emergency department visits annually throughout the United States. The majority of these patients do not have life or limb threatening injuries and are often triaged as low acuity. Compartment syndrome, on the other hand, is a true orthopedic emergency and providers must have a high index of suspicion to detect this limb-threatening pathology.

Compartment syndrome occurs when elevated pressure within the muscular compartment of a limb prevents venous drainage. This, in turn, disrupts arterial perfusion to the muscles and nerves within that compartment. If not detected in a timely fashion, compartment syndrome can lead to ischemia, infarction, and Volkmann's contractures. While it is typically seen in the setting of fracture, it can occur in any situation where there is

**TABLE 2. Compartment Pressure**

Normal	0-10 mmHg	Delta (⊗) Pressure = Diastolic Pressure — compartment pressure ⊗P ≤ 30 mmHG <b>Requires Emergent Fasciotomy</b>
Elevated	20-30 mmHg	
Emergency	30 + mmHg	

increased content, decreased volume, or prolonged external pressure in or on a compartment. Other, less commonly seen, causes of compartment syndrome include prolonged downtime in a fixed position, intensive use of a muscle during exercise or seizure, excessive traction on a fractured limb, leaking dialysis cannula, or pressure infusions. Classically, the symptoms of elevated compartment pressure are taught as the “5 P’s.” (Table 1.) However, delaying diagnosis until all findings are observed can be a critical mistake.

While compartment syndrome is a clinical diagnosis, measuring compartment pressures can assist in its diagnosis. Pressure measurements are obtained via manometry, commonly by using a Stryker tonometer. Normal compartment pressure is 0-10 mmHg. Emergent fasciotomy should be

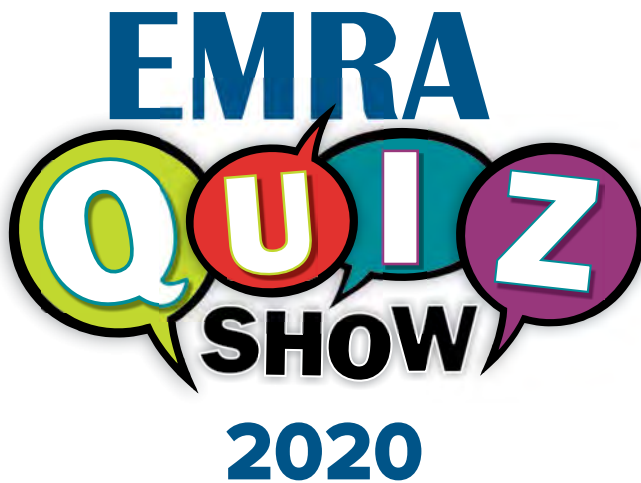
considered at pressures greater than or equal to 30 mmHg. The delta pressure can also be obtained as a surrogate marker of compartment perfusion (Table 2).

Once the diagnosis of compartment syndrome has been established, either clinically or by tonometry, immediate intervention must take place. The gold standard for treatment of compartment syndrome is fasciotomy. This procedure should be performed by a surgeon, but can be performed by emergency medicine physicians if in an austere or isolated practice environment. Patients who have elevated pressures or symptoms concerning for development of compartment syndrome with an appropriate mechanism deserve admission to the hospital for observation and serial examinations.

**Compartment syndrome is a true orthopedic emergency. Timely diagnosis and effective management are essential to preventing limb-threatening injury.**

**Conclusion**

There are very few orthopedic emergencies, but compartment syndrome is without a doubt one of them. Timely diagnosis and definitive management are essential in preventing limb threatening injury and long term complications. When in doubt, call your friendly orthopedic surgeon for assistance. ★



**Sunday, March 8**  
**5:30 – 7:30 pm**  
*CORD Academic Assembly*  
in New York City

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# A Bump in Mumps

## Is Your MMR Knowledge Updated?

Ryan O'Halloran, MD, MS

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@rto3

**A** 20-year-old female presents to your city hospital emergency department complaining of two days of subjective fevers, chills, diffuse muscle aches, as well as noticing painful swelling of her right cheek. Her review of systems is otherwise largely unremarkable. She was born in the United States, has not traveled recently, has no TB risk factors aside from living in a group setting in her local college dorm, and was fully vaccinated as a child.

She is well-appearing and has normal vital signs other than a temperature of 100.8 F. On exam she has unilateral, mildly tender swelling of the right side of her face. It's not particularly erythematous compared to the left cheek. There is no fluctuance or induration, and it does not appear markedly swollen inside the mouth. She has good dentition and no lymphadenopathy.

### Diagnosis

The differential diagnosis for a unilateral glandular, soft tissue, or lymph swelling of the face and neck is not terribly large. The area of concern isn't expanding or pulsatile, so a dangerous vascular pathology is unlikely. The dangerous deep space infections, e.g. Ludwig's angina, are unlikely because it is unilateral above the mandible without associated trismus, voice changes, or drooling. The relatively quick development suggests against malignancy. Sjögren's syndrome, or sarcoidosis are possible in the right clinical context. She has infectious signs and symptoms, without fluctuance which makes abscess unlikely and a bedside ultrasound did not demonstrate a fluid collection, or sialolith. The most likely diagnosis is parotitis, which can be unilateral, or bilateral. As with any parotitis, mumps ought to be considered.

Viral parotitis is typically a shorter duration of less than five days and is not associated with purulent drainage from Stensen's duct. Bacterial, suppurative parotitis is most commonly caused by *Staphylococcus aureus*. Viruses causing parotitis in addition to mumps include influenza A, parainfluenza, adenovirus, coxsackievirus, Epstein-Barr virus (EBV), cytomegalovirus (CMV), herpes simplex virus (HSV), human immunodeficiency virus (HIV), and lymphocytic choriomeningitis virus (LCMV).

In 25% of cases, the swelling is unilateral, though in many cases one side will present symptomatically prior to the opposite side. Swelling typically peaks on day 3 of the illness and subsequently improves. It can often be confused with lymphadenopathy, though mumps more characteristically swells anteriorly to the angle of the mandible which can obliterate the ability to palpate the angle of the mandible, and may cause protrusion of the ear.

Mumps is a paramyxovirus diagnosed best by viral nucleic acid PCR. Blood serologies for mumps IgG and IgM are often "send-out" style labs and are complicated by the patient's vaccination status and length of illness.

### Treatment and Complications

Mumps, like many viral illnesses, is typically self-limited and only supportive therapy is necessary. Use warm, or cold compresses in addition to NSAIDs for discomfort. In the vast majority of cases, admission, or further therapy is unnecessary. Worrisome complications in vaccinated individuals such as encephalitis, orchitis, or sensorineural

hearing loss are rare, but aseptic meningitis remains the most common complication in 1 to 10% of cases. Approximately one-in-three to one-in-five unvaccinated patients develop orchitis typically 7 to 10 days following parotitis, compared to orchitis only occurring in 7% of vaccinated patients.

The virus is thought to be most often contagious from 2 days prior to the onset of parotitis to 5 days after. Typical isolation recommendations include avoiding close contacts from the time of diagnosis until five days after the onset of parotitis. Vaccination with a third, "booster" dose in addition to the two-dose typical MMR series may be helpful in reducing the likelihood of infection in close contacts but does not offer an added benefit to the infected patient.

### Reporting

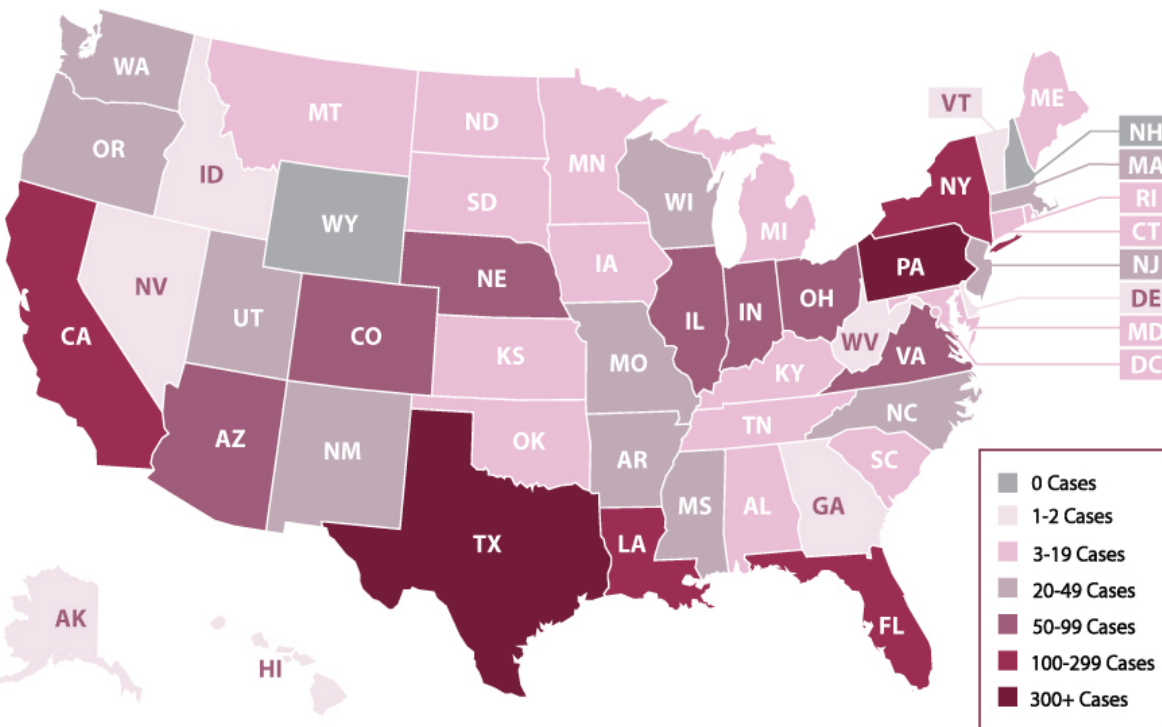
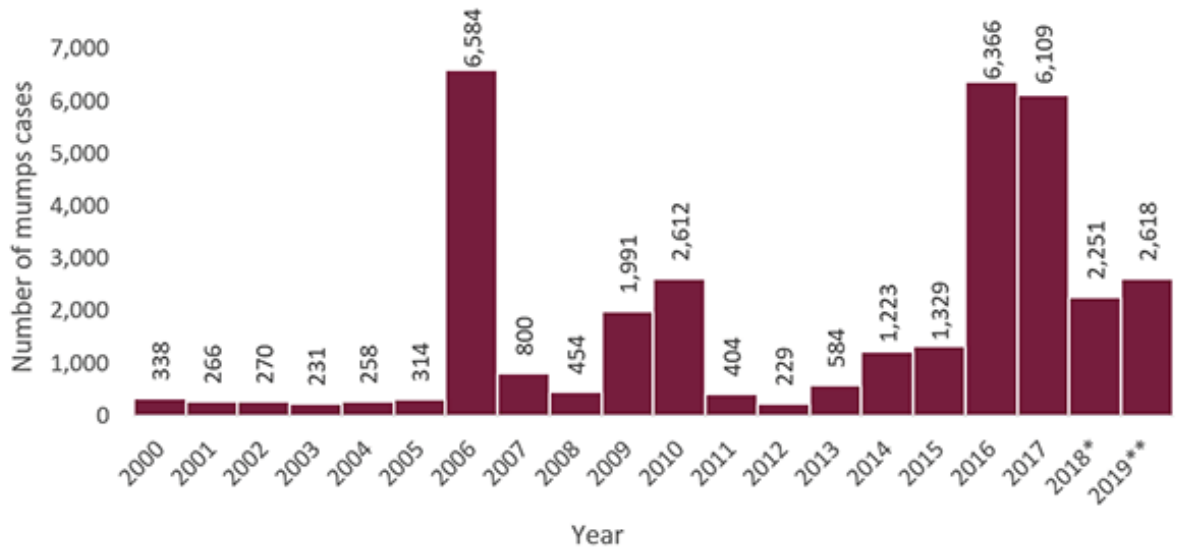
City and state health departments like to track the incidence of vaccine-preventable communicable diseases. Mumps is not a mandatory reportable illness or outbreak to the CDC which is defined as three or more cases linked by time or place. However, the CDC does track data and cases should be reported to your local health department. In New York City, the health department performs testing to confirm the diagnosis and continues routine follow-up with the patient after hospital discharge. Since viral shedding occurs before the typical viral syndrome and respiratory symptoms, contacts should be monitored for illness development. The incubation period for the virus ranges from roughly two to three weeks.

### TAKE-HOME POINTS

1. Mumps, a vaccine-preventable illness, is a self-limited paramyxovirus, diagnosed by viral PCR swab, whose treatment is entirely supportive care.
2. Parotitis is unilateral in up to 25% of cases, but typical presentations are bilateral.
3. Close contacts should be avoided from the time of diagnosis until five days after the onset of parotitis. Vaccination may be effective in preventing illness in close contacts.
4. Cases of mumps should be reported to your local, city, or state health department.

**FIGURE 1.**  
**Reported**  
**Mumps Cases,**  
**United States,**  
**2000-2019**

SOURCE: [HTTPS://WWW.CDC.GOV/MUMPS/IMAGES/OUTBREAKS-GRAPH.PNG](https://www.cdc.gov/mumps/images/outbreaks-graph.png) MORBIDITY AND MORTALITY WEEKLY REPORT (CDC)



**FIGURE 2.**  
**Reported**  
**Mumps Cases,**  
**United States,**  
**2019**

SOURCE: [HTTPS://WWW.CDC.GOV/MUMPS/IMAGES/MUMPS-OUTBREAK-MAPS.PNG](https://www.cdc.gov/mumps/images/mumps-outbreak-maps.png) (CDC)

**Discussion**

The recent popular discussion of measles has placed the focus on one of the three viruses contained in the typical MMR (measles, **mumps**, and rubella) vaccine series, but not the rest. The MMR vaccine was introduced in 1989, which resulted in a 99% decrease in reported cases of mumps. Cases occur throughout the world, most commonly in late winter to spring.

Mumps cases are on the rise since 2006 both in overall numbers and in number of outbreaks reported to the CDC.

In the United States, many outbreaks and several thousand cases of mumps have occurred over the last 20 years, the largest of which involved 3,000 cases in a tight-knit community in rural Arkansas in 2016. From January to July 2019, 1,799 cases have been reported in the United States, involving 45 states and the District of Columbia.

Cases have shifted from once being a common childhood viral illness to one of young, vaccinated adults. This suggests the possibility that vaccine effectiveness declines with time. The MMR series is 2 vaccines, thought to be approximately 78% effective at preventing disease after the first vaccine, and 88% effective at preventing disease following the second vaccine in the series. \*

# Ultrasound Guided Erector Spinae Plane Block for Acute Management of Rib Fractures

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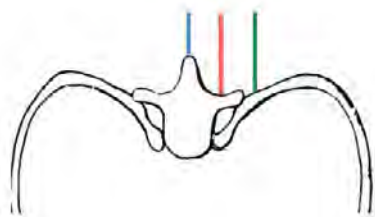
Jane Xiao, MD

Oregon Health and Sciences University

**A** frail, elderly female presents after a ground-level fall with chest wall pain. Her trauma evaluation reveals T8 – T9 posterior rib fractures, and you note that she takes cyclobenzaprine as needed for chronic back pain. The patient receives morphine, but the nurse comes to you several times asking for more pain medications. You understand the importance of pain control in rib fractures, but are also concerned about opiate induced respiratory depression. What can you do to safely control her pain and possibly discharge her home?

## Background

Rib fractures are common injuries, often occurring following blunt thoracic trauma. Approximately 10% of blunt trauma patients are found to have rib fractures, which can be associated with significant morbidity and mortality.<sup>1</sup> Elderly patients are particularly susceptible to associated complications with pneumonia rates as high as 31%.<sup>1</sup> Providing effective analgesia helps to prevent these complications, ICU stays, and even death. Opioids are usually the mainstay of treatment, however their side effects of respiratory depression, cough suppression, and delirium also contain risk for complications.<sup>4</sup> Using



**IMAGE 1. Three Sonographic Planes to Visualize**

regional anesthesia for the treatment of rib fractures has been shown to improve pulmonary function, including tidal volume and inspiratory force, and overall clinical outcomes when compared to treatment with opioids.<sup>5</sup> In this article, we describe one regional nerve block that is particularly safe and effective in treating pain associated with rib fractures, the erector spinae plane block.

## Procedure

The erector spinae plane is located just posterior to the spinous transverse processes and anterior to the erector spinae muscles. The erector spinae plane block (ESPB) primarily targets the dorsal and ventral rami of the thoracic spinal nerves, providing pain relief to the posterior chest wall via the former and to the anterolateral chest wall and injured periosteum via the latter.<sup>6</sup> Whereas the serratus anterior block covers only anterolateral chest wall pain, the ESPB is able to cover the posterior thorax as well.

The ESPB uses standard nerve block supplies, which includes a 25-27 gauge needle for local anesthetic and a standard 20 gauge block needle. If a block needle is not available, a Quincke tip lumbar puncture needle will work as well. We recommend a preparation of 30 mL of 0.25% bupivacaine (2 mg/kg max) to allow adequate spread of the anesthetic within the fascial plane.

While a high frequency linear array transducer is generally better for high resolution images, in our experience the curvilinear transducer obtains better visualization of the important bony structures in overweight and obese patients. (See Image 1)

To begin the procedure, position the patient in a sitting or lateral decubitus position with the unaffected side against the bed and establish your sterile field.

Start with the transducer in midline



**IMAGE 2. At the Midline, The Spinous Processes Appear Triangular or Like Shark Fins**

sagittal orientation to identify the thoracic spinous processes, which appear triangular like shark fins (Image 2).

Slowly move the probe laterally about 2 – 3 cm to visualize the transverse processes, which appear as elongated ovoid structures (Image 3a). The erector spinae muscles and trapezius/ rhomboid muscles lie directly above these transverse processes (Image 3b). As the probe continues to move laterally beyond this target goldilocks zone, the more superficial, circular ribs and underlying pleura come into view clearly (Image 4).

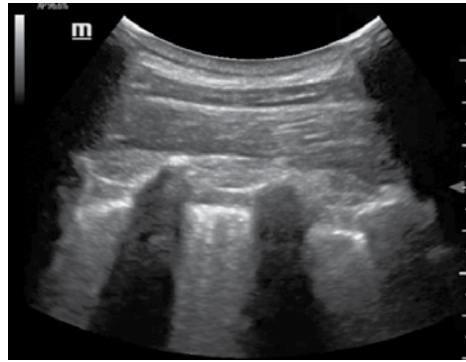
After landmarks and transverse processes are clearly identified, anesthetize the procedure site with a small wheal of local anesthetic before inserting the sturdier procedure needle in a cephalad to caudad direction. Target the injection to the plane just above the transverse process and below the erector spinae muscle, staying above the rib at all times to avoid creating a pneumothorax. Beginners may inject a small 1-2 mL aliquot of normal saline or anesthetic to confirm needle tip placement and hydrodissect fascial layers.

After the fascial layers open smoothly, slowly inject the anesthetic. As the anesthetic is injected, the erector

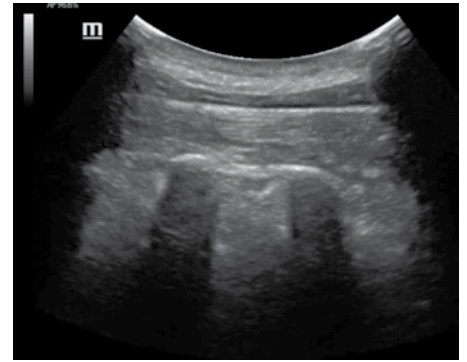




**IMAGE 3A. The Thoracic Transverse Processes Have a Gentle Curvilinear Contour. This Is The Target Goldilocks Zone.**



**IMAGE 3B. The Erector Spinae Plane is Located Between these Erector Spinae Muscles and Transverse Processes**



**IMAGE 4. The Ribs Appear More Superficial and Rounded**

spinae muscles should lift away from the transverse processes, revealing the erector spinae plane and neighboring transverse processes. We recommend waiting about 30 minutes to evaluate the full efficacy of this block.

The advantage of a ESPB is that the site of injection is distant to pleura, major blood vessels, and the spinal cord so there are relatively few contraindications. In

addition, the local anesthetic spreads cranio-caudally along the fascial plane, providing pain relief to multiple vertebral levels with a single injection.

Absolute contraindications include allergy to local anesthetics, active overlying skin infection, or patient refusal. It is advised to reconsider or postpone injection in patients with pre-existing neurologic deficits along

distribution of the block and in patients with coagulopathies.<sup>3</sup>

**Case Conclusion**

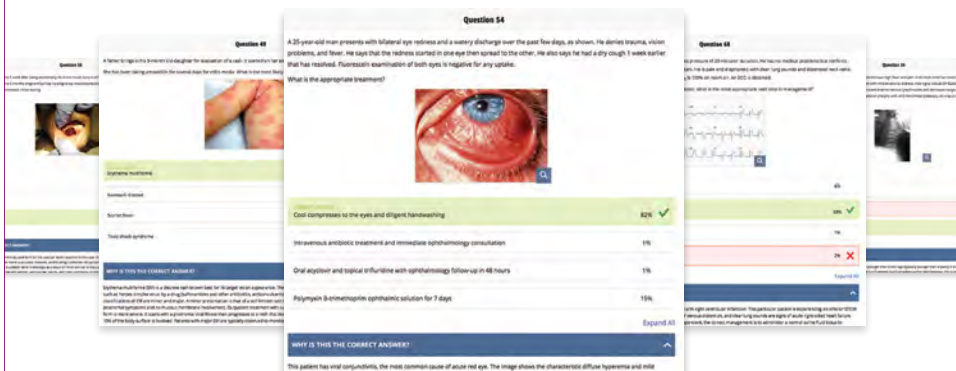
An ultrasound-guided ESPB is successfully performed and half an hour later the patient is able to breathe and move comfortably. She is amenable to discharge home with an incentive spirometer and does not require admission. ★

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# Performance Enhancing Drugs

## A Review of Non-Steroidal Drugs of Abuse

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Performance enhancing drugs (PEDs) are commonly used by competitive, professional, and Olympic athletes. It has been estimated that there are at least 3 million PED users in America, which puts PED use on a scale similar to commonly encountered diseases such as Type 1 Diabetes and HIV.<sup>1</sup> There are several broad categories of PEDs, including steroidal and non-steroidal. In a patient presenting to the emergency department with PED abuse, the history and physical exam are critical in identifying the etiology of the patient's illness because most PED test results will not be available to guide emergency department management. Although uncommon, the emergency department provider must be prepared to identify and manage these unusual toxidromes. Patient history may be especially challenging in this population as they may be reluctant to acknowledge their PED use. This review covers some of the non-steroid options which are commonly used by athletes and weightlifters of both amateur and professional status.

### STIMULANTS

Athletes use stimulants due to perceived benefits such as increased energy, stamina, muscle strength, and fat loss. One stimulant, ephedrine, acts on the central nervous system by increasing the release of noradrenaline as well as stimulating alpha and beta receptors. Through these effects, it increases peripheral vasoconstriction which leads to increased blood pressure. It also increases heart rate and cardiac

output. Ephedrine can improve cognitive and physical performance,<sup>2</sup> as well as cause people to feel anxious, high, or stimulated.<sup>3</sup> Ephedrine has been used medically for asthma and allergies due to its decongestant properties and effect as a bronchial smooth muscle relaxer. Other stimulants of abuse include synephrine and caffeine.

**Presentation.** Ephedrine is similar in structure to methamphetamine and can present acutely with a sympathomimetic toxidrome. However, the effects of ephedrine are much less potent and longer acting than amphetamines. Side effects of ephedrine include anxiety, tremors, psychosis, irritability, headache, and dizziness. Overdose can also cause confusion, hallucinations, convulsions, and difficulty with respiration. The most serious potential signs and symptoms of overdose include rapid, irregular heartbeat and significantly elevated blood pressure. There is at least one documented case of acute myocardial infarction in a young patient with no cardiac risk factors who was taking an ephedrine product.<sup>4</sup> Another study reported a patient who used ephedrine chronically and developed pulmonary edema, congestive heart failure, and myocardial necrosis. Five years after stopping ephedrine, the patient was symptom free with improvement in previously reduced left ventricular ejection fraction.<sup>5</sup> Adverse reactions have been documented when ephedra is taken in doses greater than 32 mg/day.<sup>6</sup>

Synephrine increases metabolism and energy expenditure,<sup>7</sup> but does not lead to weight loss.<sup>8</sup> A study of adverse effects in humans revealed that synephrine did not significantly change serum chemistries, urinalysis, blood cell counts, blood pressure, heart rate, or EKG data.<sup>7</sup> There is one study that reported a patient taking an herbal supplement which consisted of synephrine, caffeine, and guarana who presented to the emergency department with headaches and a blood pressure of 234/130. The authors utilized the Naranjo

Adverse Drug Reaction Probability Scale to suggest that an adverse drug reaction was the probable cause.<sup>9</sup>

Caffeine is a methylxanthine, which is a pharmaceutical class with mild stimulant and bronchodilator effects and guarana is an herb which contains caffeine. One important distinction related to caffeine is that it is not an adrenergic stimulant, but rather it acts on adenosine receptors which inhibits drowsiness. From the perspective of the emergency department provider, caffeine still presents similar to other stimulants and is managed similarly.

**Diagnosis.** The diagnosis is primarily clinical. Both ephedrine and synephrine may cause a positive amphetamine result on a urine drug screen because of their similar chemical structures.<sup>10</sup> Testing for ephedrine and synephrine specifically is not routinely available in the ED.

**Treatment.** In general, patients presenting with a stimulant or sympathomimetic toxidrome should be treated with benzodiazepines. In patients presenting with seizures, benzodiazepines remain the drug of choice. In general, benzodiazepine administration should be titrated to stabilize vital signs and mental status. In rare, critical cases, phentolamine sulfate 5 mg IV or 100 mg po should be considered and dexamethasone can be administered for life threatening hyperpyrexia. Early consultation with a medical toxicologist and/or poison center (1-800-222-1222) is recommended when managing these patients.

### BETA 2 AGONISTS

While beta 2 agonists have well documented utility in the treatment of asthma and COPD, there is also potential for abuse of these agents. Beta agonists have shown benefits for athletes such as increased protein turnover in skeletal muscle after resistance training<sup>11</sup> and increase in lean body mass.<sup>12</sup>

**Presentation.** Side effects of beta 2 agonists include tremors, anxiety, and palpitations. Tremor has been correlated with hypokalemia, so evaluating and correcting potassium is recommended.<sup>13</sup>

**Diagnosis.** The diagnosis is primarily clinical. These substances are detected in the urine via ELISA, although testing for beta agonists is not readily available in most emergency departments.

**Treatment.** Benzodiazepines and beta blockers may be used to treat overdose symptoms in the acute setting if heart rate and blood pressure can tolerate it. Early consultation with a medical toxicologist and/or poison center (1-800-222-1222) is recommended when managing these patients.

## MELDONIUM

Meldonium is a substance used by athletes because it has been proven to improve exercise tolerance<sup>14</sup> and rehabilitation after exercise.<sup>15</sup> Meldonium acts by interfering with L-carnitine metabolism via inhibiting GBB hydroxylase. This results in increased ATP generation, increased glucose consumption, and protects the mitochondria from free fatty acid overload. Meldonium also has beneficial effects on memory and neuroinflammation. In rat studies it has been shown to reduce glycated hemoglobin, increase glucose tolerance, and protect against cardiac ischemia. Meldonium is approved for use in some European countries for stable angina and in others for bronchitis or asthma.

**Presentation.** Side effects of meldonium are not well described and there is no clear clinical toxidrome. Two side effects listed on the drug label include tachycardia and reduction in blood glucose.<sup>16</sup>

**Diagnosis.** The diagnosis is based primarily on history of present illness as there are no clear clinical or laboratory indicators. Testing for meldonium is not readily available in most emergency departments.

**Treatment.** There is no known antidote for meldonium. Tachycardia can be treated with benzodiazepines and rate controlling agents, while blood glucose can be managed with glucagon

or carbohydrate rich food and drink. Early consultation with a medical toxicologist and/or poison center (1-800-222-1222) is recommended when managing these patients.

## CREATINE

Creatine has long been used by athletes and weightlifters because it increases strength and power in high intensity exercises over a short duration of time and it also increases lean body mass.<sup>17</sup> Creatine is available over the counter and is a legal substance, but it is abused by athletes who take amounts greater than the recommended dose or for prolonged periods of time. Short term creatine supplementation increases blood levels of phosphocreatine, which is used to increase ATP production by cells with high energy requirements.<sup>18</sup>

**Presentation.** Some side effects of creatine are due to its osmotic effect, which decreases urinary volume and causes urinary retention. This can lead to increased risk for muscle cramps, heat-related illness, and dehydration.<sup>19</sup> One of the more serious side effects include an increased risk for compartment syndrome due to its osmotic effects. There has also been a case report of acute hepatotoxicity in a patient who took creatine above the recommended dose. There is no standard dose of creatine, but 0.07 g/kg of body weight has been suggested in the literature.<sup>20</sup>

**Diagnosis.** The diagnosis is primarily clinical. The physician should be particularly attentive to renal function, liver function, and electrolyte disturbances and should perform a thorough musculoskeletal exam. Testing for creatine is not commonly available in the ED.

**Treatment.** There is no antidote for creatine overdose. Adverse effects of the substance can be treated symptomatically. If there is concern for urinary retention, a bladder scan and straight catheterization should be performed as indicated. Electrolytes and liver profile should be monitored in patients suspected of creatine overdose. If there is hepatotoxicity, the main treatment is to stop the use of creatine. Caution should also be utilized when using medications which are metabolized

via the liver. Early consultation with a medical toxicologist and/or poison center (1-800-222-1222) is recommended when managing these patients.

## GAMMA HYDROXYBUTYRATE (GHB)

GHB may be used for performance enhancing reasons because it is believed to improve exercise performance and muscle mass. There is evidence to support that GHB increases growth hormone concentration without onset of sleep.<sup>21</sup> GHB acts by binding to the GABA-B receptor to cause CNS depression.<sup>22</sup>

**Presentation.** Patients with GHB overdose or abuse will typically present to the emergency department with CNS and respiratory depression. Other side effects of GHB can include seizures, hypotension, amnesia, aggressiveness, hypotonia, hallucinations, and dizziness.

**Diagnosis.** GHB can be detected in the hair for months after use, but for emergency department purposes, it can be detected in the urine within 12 hours of ingestion.<sup>23</sup>

**Treatment.** There is no reversal agent available for GHB. Patients with GHB toxicity should be watched closely and treated symptomatically. Some GHB intoxicated patients may require mechanical ventilation or vasopressors depending on severity of respiratory and cardiovascular depression. Patients might recover within 4-6 hours while still in the emergency department. Early consultation with a medical toxicologist and/or poison center (1-800-222-1222) is recommended when managing these patients.

## CALCIUM CHANNEL BLOCKERS AND BETA BLOCKERS

Calcium Channel Blockers (CCBs) and Beta Blockers (BBs) may be abused by athletes who participate in sports where a slow heart rate is beneficial, such as archery.

**Presentation.** Both CCBs and BBs can cause EKG changes such as QT prolongation, first degree AV block, and bundle branch block. Mild side effects of CCBs include peripheral edema and elevated blood sugar. Overdose can lead to shock, acute kidney injury, and there have been rare case reports of death



due to CCB overdose.<sup>24, 25</sup> Common side effects of BBs include bronchospasm, dyspnea, diarrhea, nausea, bradycardia, hypotension, sexual dysfunction, hypoglycemia, and hypokalemia. Seizures are another, more serious, adverse effect of beta blocker toxicity.

**Diagnosis.** The diagnosis is primarily clinical. Testing for CCBs and BBs is not commonly available in the ED.

**Treatment.** Treatment is guided by the suspected degree of toxicity. If CCB or BB toxicity is suspected, then point-of-care blood glucose, serum electrolytes, and serial EKGs should be monitored. If the patient presents to the ED within 1 hour of overdose ingestion, activated charcoal is recommended for both CCBs and BBs if no concern for aspiration exists.<sup>26</sup> Multi-dose activated charcoal is a reasonable option in patients ingesting sustained release preparations if the airway is stable or protected and their gastrointestinal tract is intact. In cases of extended release formulations, delayed administration of activated charcoal and/or whole-bowel irrigation may be of benefit if no contraindications are present. Orogastric lavage may be considered in patients with significant toxicity with a protected airway. For both CCBs and BBs, it is recommended to start with atropine (if needed) and then proceed to IV glucagon (ideally should be given with an antiemetic), IV calcium gluconate, IV high-dose insulin therapy with glucose (hyperinsulinemia-euglycemia therapy), and isotonic fluids. Catecholamine vasopressors and phosphodiesterase inhibitors may also be utilized if initial treatments fail. In severe refractory cases, lipid emulsion therapy may be an option. Other management considerations for BBs include sodium bicarbonate if the patient has QRS widening or magnesium sulfate if there is QTc prolongation. Unless mild, most patients with BB or CCB overdose will require admission to the hospital. Early consultation with a medical toxicologist and/or poison center (1-800-222-1222) is recommended when managing these patients.

## CANNABINOIDS

Cannabis has well-documented recreational use, but athletes may also use the substance as a performance

enhancer to reduce pain and anxiety. Additionally, cannabis increases focus and propensity to take risks, which can be of benefit in certain sports. However, one review of 15 studies found that it does not improve strength or aerobic exercise tolerance.<sup>27</sup> Cannabinoids work as CB1 and CB2 receptor agonists, which are found in the brain and peripheral tissue, respectively.<sup>28</sup>

**Presentation.** Side effects of cannabinoids include cardiac and respiratory depression as well as impaired attention, anxiety, panic, and impaired memory. One common presentation is cyclic vomiting syndrome or cannabis hyperemesis syndrome. Patients with this condition have acute episodes of vomiting for less than 1 week. Another side effect of cannabis is acute psychosis. Other serious side effects may be seen when marijuana is mixed or laced with other more dangerous drugs.

**Diagnosis.** The diagnosis is often clinical and laboratory testing is unnecessary. THC, the active ingredient in cannabinoids, can be detected in several different ways—it can be measured in sweat, urine, blood, hair, and oral fluid. In the emergency department, cannabis can be tested in the urine. It is important that the emergency physician consider synthetic cannabinoids or cannabinoids laced with other drugs of abuse.

**Treatment.** Treatment of cannabis intoxication is supportive. If patients have been vomiting, they can be treated with IV fluids, electrolyte replacement as indicated, and antiemetics. For patients experiencing cannabis hyperemesis syndrome, hot baths have shown therapeutic benefit and have more supporting evidence than pharmaceutical antiemetics. There is no antidote for cannabis intoxication.

## DIURETICS (MASKING AGENTS)

Masking agents may be used by athletes in an attempt to avoid detection of PED use. The most common masking agent is a diuretic. There are varying mechanisms depending on the type of diuretic, but all diuretics dilute the urine by increasing water loss in the urine.

This is beneficial to athletes using PEDs because diluted urine leads to lower concentration of the banned substance. Ideally for the athlete, the concentration of the illegal substance will not be detected or will be under the legal limit as a result of the dilution. In some sports, diuresis may be beneficial for weight loss such as in wrestling or mixed martial arts.

**Presentation.** Abuse of diuretics can lead to hypotension and electrolyte imbalances such as hypomagnesemia, hypokalemia, hyperglycemia, and hyperuricemia, which may lead to gout.

Most severely, diuretic abuse can lead to severe hyponatremia, central pontine myelinolysis, and renal injury.<sup>29</sup>

**Diagnosis.** The diagnosis is primarily clinical. Diuretics can be tested via the urine, although this test is not commonly available in the ED.

**Treatment.** There is no antidote available and diuretic toxicity should be treated symptomatically. If patients present with concern for diuretic toxicity, then blood pressure, serum electrolytes, and EKG should be monitored closely. If sodium is abnormal, it should be corrected slowly with a goal change in sodium of no more than 6-8 mEq in 24 hours.

## Conclusion

There are a wide variety of PED options for athletes beyond the classically considered androgenic hormones. The incidence of these patients presenting to the emergency department is not well studied, but is likely rare. However, patients may not volunteer their drugs of abuse and the clinical toxidromes can be challenging to diagnose and manage in the uncooperative patient. In many cases, the emergency medicine physician may not know the drugs of abuse at the time of presentation. This review serves to describe some of the non-steroidal performance enhancing drugs of abuse that may present to the emergency department setting and potential challenges in diagnosis and management. In general, early consultation with a medical toxicologist and/or poison center (1-800-222-1222) is recommended when treating these patients. \*

# PENILE MONDOR'S DISEASE

## *Rare or Just Underdiagnosed?*

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**A** 30-year-old male with no significant past medical history presented to the ED with complaints of penile pain for 4 days. He stated he was urinating when he developed sudden pain and swelling at the base of his penis. He had associated intermittent pain with urination. He reported no fever, vomiting, abdominal pain, changes in bowel habits, hematuria, urethral discharge, or testicular pain or swelling. He had no past medical history of or known exposure to STI. He is sexually active with one female partner; they are monogamous and do not use regular contraception.

On physical exam, he had moderate tenderness to palpation at the base of the dorsal penis with mild perineal swelling and a palpable subcutaneous rope-like structure along the dorsum of the penis. Urinalysis and gonorrhea/chlamydia screens were negative. Ultrasound of the scrotum and penis demonstrated

*superficial occlusive venous thrombosis of the penile dorsal superior vein with normal appearance of both testicles and no testicular mass or torsion at the time of imaging (Figures 1 and 2). He was discharged home with recommendations by urology to take 325 mg aspirin daily for 14 days.*

### Discussion

Penile Mondor's disease (PMD) is a benign thrombophlebitis of the superficial dorsal vein of the penis, typically presenting acutely as a subcutaneous, rope-like band on the dorsal penis with or without pain. Although its pathogenesis is not clearly understood, PMD is thought to most often be caused by trauma during sexual intercourse, resulting in endothelial injury and intravascular coagulation.<sup>1</sup> Other proposed causes include penile trauma, prolonged sexual abstinence, local infections, a history of STIs, thrombophilia, repair of inguinal hernia, orchiopexy, varicocele, use of intracavernous drugs, Behçet's disease, tumors, migratory phlebitis due to paraneoplastic syndromes, venous occlusion caused by filled bladder, abuse of IV drugs, and tendency of thrombosis.<sup>6</sup>

While the prevalence is estimated to be approximately 1.4%, it is believed to be

an under-reported and under-diagnosed medical condition mostly affecting sexually active men ages 21-70.<sup>3</sup>

Diagnosis can often be established through H&P, as patients typically present with pain during erection and palpable swelling and hardness on the dorsal surface of the penis. There are no lab tests or markers specific to PMD, but ultrasound is useful to rule out other fibrotic lesions of the penis, including sclerosing lymphangitis, Peyronie's disease, and angioedema. Sclerosing lymphangitis is characterized by thickened and dilated lymphatic vessels with serpiginous morphology, and Peyronie's disease involves well-defined, fibrotic, and calcified plaques involving the tunica albuginea of the penis.<sup>5</sup>

Since PMD is a self-limiting condition, treatment is conservative, with patients being instructed to avoid sexual activity until symptoms resolve (6-8 weeks). Medical therapy may also be indicated, including aspirin or oral anticoagulants until the thrombophlebitis resolves. If necessary, NSAIDs may be added to combat pain and swelling. Appropriately managed, PMD does not cause permanent deformity or erectile dysfunction, although prompt diagnosis may relieve psychological stress.<sup>5</sup> ★



# Who Art Thou? Neck Swelling!

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A 14-year-old female of Middle Eastern descent with history of hypothyroidism, vitamin D deficiency, and iron deficiency anemia presented with a 3-week history of right neck swelling and pain. Initial evaluation at an urgent care prompted a diagnosis of lymphadenitis, and clindamycin was prescribed (discontinued after 4 days due to GI intolerance). With persistent swelling and worsening pain, she presented to a pediatric ED, where her vital signs were unremarkable and she was noted to have swelling and tenderness over the right anterior cervical lymph nodes. An ultrasound of the neck showed a cluster of enlarged lymph nodes without abscess formation. Laboratory workup including a CBC with differentials was unremarkable. With positive EBV titers, a diagnosis of infectious mononucleosis and acute cervical lymphadenitis was made, and cephalexin prescribed (discontinued after 3 days due to GI intolerance).

On the 8<sup>th</sup> day after initial presentation she followed up with her primary care provider for persistent swelling and pain and attested to difficulty in flexing and extending her neck secondary to pain. A purified protein derivative test and a chest radiograph to evaluate for tuberculosis were non-contributory.

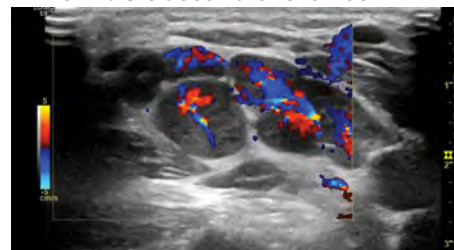
When evaluated by a hematologist 4 weeks after onset of symptoms, there was no concern for a malignancy, but with significant swelling and tenderness she was sent back to the ED for evaluation. In addition, she reported 3 pounds of unintentional weight loss as well as difficulty opening and closing her mouth secondary to pain, and pain behind the right ear. She had remained afebrile throughout her presentation.

On arrival to the ED, her vital signs were again unremarkable. After pain control, laboratory work was obtained, which showed no evidence of malignancy, inflammation, or infection. A repeat neck US demonstrated multiple enlarged lymph nodes without central necrosis, and abscess formation in the right anterior and posterior cervical chain (Image 1). She was started on intravenous antibiotics, pain medication, and admitted for further management.

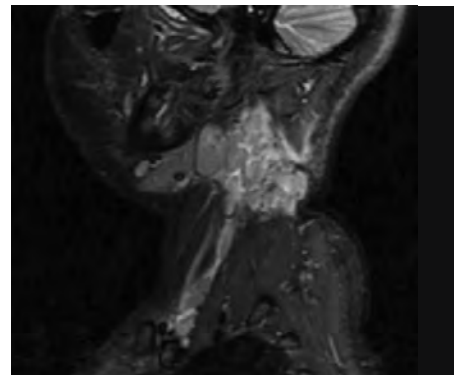
With persistent pain despite treatment, a third US neck demonstrated a progression in the size and number of non-necrotic lymph nodes with hyperemia, but no evidence of fluid collection or abscess. Studies including Bartonella PCR, atypical mycobacterial pathogens, and TB quantiferon were negative. A CT scan of the neck was performed, showing right sided lymphadenopathy with minimal soft tissue stranding along the posterior neck, suggestive of inflammation with no abscess formation (Image 2). A biopsy of the lymph nodes was performed and a rheumatologic workup was positive for antinuclear antibody and extractable nuclear antigen. Chest radiograph and abdominal US to rule out sarcoidosis were negative.

Post biopsy — despite surgical debulking — she had several large (2-3 cm), painful lymph nodes in the right posterior cervical chain. Pain worsened and she reported no relief despite opioids for pain control. On hospital day 6 she further developed restriction of motion of her right arm and decreased sensation over her right side shoulder and biceps, consistent with neuropathic pain. Neck MRI demonstrated a conglomerate of large enhancing lymph nodes in the neck, supraclavicular and right paratracheal

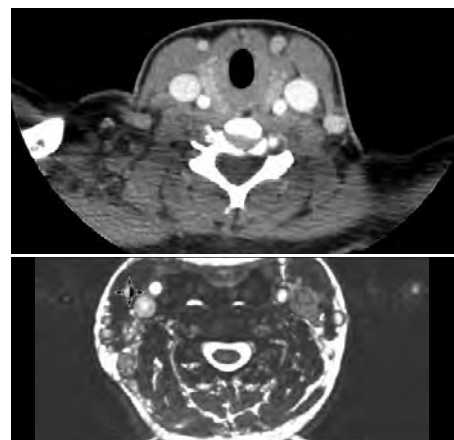
**IMAGE 1. Ultrasound of the neck**



**IMAGE 2. CT scan of the neck**



**IMAGES 3 and 4. MRI of the neck**



region in close proximity to the brachial plexus (Images 3, 4).

Histopathology reports showed histiocytic necrotizing lymphadenitis. Oral steroids were started; pain and lymphadenopathy resolved and she was discharged home to follow up with rheumatology, with a final diagnosis of Kikuchi-Fujimoto disease (a rare, benign, self-limiting, non-caseating granulomatous disease of cervical lymph nodes with an unknown etiology). \*

## TAKE-HOME POINTS

1. While infectious etiology should always be considered for unilateral neck swelling, the differential diagnoses need to be broad (neoplastic processes, chronic inflammatory conditions, and autoimmune causes).
2. Lymph node biopsy should be considered early for lymphadenitis/lymphadenopathy not responding to antibiotics.
3. Awareness of common and uncommon etiologies of unilateral neck swelling enables the EM/PEM physician to initiate the most appropriate evaluation and referrals.



# Reflections on Innovation & Entrepreneurship in Emergency Medicine

*A Panel Discussion with James Dahle, Stephanie Gravenor, and Jesse Pines*

**Nicholas Stark, MD, MBA**

UCSF Emergency Medicine Residency  
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**A**t ACEP 2019, EMRA's Administration & Operations Committee hosted 3 leaders with a diverse array of experiences in innovation and entrepreneurship:

- **James Dahle, MD**, a ground-breaking entrepreneur in physician-tailored personal finance who founded the White Coat Investor blog, books, and community on which countless physicians have come to rely,
- **Stephanie Gravenor, MBA**, an innovative entrepreneur with a background in industrial engineering who is making waves in health care operations management through her new company, Medecipher; and,
- **Jesse Pines, MD, MBA, MSCE**, a renowned researcher in emergency department economics who is working to transform health care payment and delivery models, catalyzed most recently by his new role as National Director of Clinical Innovation at US Acute Care Solutions.

Each panelist spoke about their unique story, illuminating how their personal journey drove their aspirations and ultimately fueled their success. Pines' past as a Congressional intern in DC taught him how to never take "no" for an answer. Later, as a first-year resident, that same persistence in the face of skepticism led him to establish a massive,

productive research enterprise. Gravenor had once felt hopelessly powerless when she saw her sister, who had been seriously injured in a terrorist attack, receive poorly coordinated care in a US hospital after transfer from a European facility; since then, she has vowed to fix health care systems in disarray. Dahle had become frustrated after feeling cheated by the financial services industry when he

was sold woefully subpar investment and insurance products; he has since worked tirelessly to ensure that no physician repeats those same mistakes.

These personal stories were studied with invaluable lessons for residents and students in emergency medicine who are interested in leading change. We have distilled some of these ideas into the following pearls:

## 10 Keys to Powering Ideas and Accelerating Innovation

- 1 Embrace the power of collaboration** (Pines). You can often find allies in overlooked places. Think outside the box to find others interested in supporting and building upon your ideas.
- 2 Translate ideas across disciplines** (Dahle). If something works in one field, try to see if it works in another. For example, personal finance self-help books had been around for decades; however, the White Coat Investor was the first to make personal finance specifically pertinent to a physician audience.
- 3 Transform your personal frustrations into change** (Gravenor). Necessity is a powerful driver of change. Embrace challenging situations by asking, "How can I make this better?"
- 4 Fail fast and fail often** (Dahle). Failing at something isn't a sign of weakness. We will all fail. However, if you fail quickly and recognize that failure, you can pivot to try a new and potentially successful approach.
- 5 Seek out and cultivate mentors** (Pines). Look for people a few steps ahead of where you are. Reach out and ask questions. Be intentional about maintaining those relationships.
- 6 Don't be afraid to mentor others** (Gravenor). As we continue to venture forth in our careers, sometimes it can be easy to forget how far we have already come. Share with others the lessons you have learned, and pay your experience forward.
- 7 Convince naysayers with numbers** (Gravenor). It can be hard to convince people to try your ideas on principle alone. Try to quantify the opportunity (or cost) of future directions to nudge others toward change.
- 8 Stay ahead of the curve** (Dahle). If you are continually innovating within your space, strive to be the first mover. If another party creates something promising, consider partnering with them (e.g. purchase equity in their company or idea) rather than competing directly.
- 9 Don't take "no" for an answer** (Pines). If you have a great idea that you are passionate about, do not let a lack of support stop you from pursuing it. Keep looking for people who believe in what you are doing—you may have to ask a dozen people and look in unconventional places, but support is out there somewhere.
- 10 Find your niche, but don't stress about it** (Dahle). Everyone finds their niche in different ways and at different times, and it may not be what you expect. It might be ultrasound; or, you may read about personal finance in your spare time and stumble upon your niche accidentally.

*\*The above "10 Keys to Powering Ideas and Accelerating Innovation" are paraphrased based on the panel discussion at ACEP 2019 and not direct quotations. \**



# HOTSPOTTING

## Rethinking Health Care Delivery

Joe Gannett, MD

Spirit of Charity Emergency Medicine  
LSU-NOLA

### What is Hotspotting?

In an ever-evolving health care landscape, physicians, public health officials, health care managers, and insurance companies are searching for ways to simultaneously improve quality of care while reducing cost. Health care “hotspotting” has the potential to do just this, especially in vulnerable patient populations. Hotspotting is the use of data to identify high-cost patients within a defined geographic area of a health care system. These high-cost patients, sometimes referred to as super-utilizers, account for a disproportionate share of health care dollars. In fact, it has been estimated that as little as 5% of the U.S. population accounts for more than half of total health care expenditures.

While the definition may be simple, the reason these super-utilizers exist is much more complicated. To start with, patients in this vulnerable population often suffer from multiple, chronic conditions that are related to or aggravated by socioeconomic status. This, in turn, presents barriers to their receipt of effective treatment and successful medical outcomes. These barriers include

food and housing insecurity, health illiteracy, educational challenges, mental health issues, and substance abuse. As a result, many of these patients languish in a system that isn’t designed to address complex and interrelated medical and social needs.

In the early 2000s, Dr. Jeffrey Brenner, a primary care physician in Camden, New Jersey, was determined to improve health care delivery in one of America’s most impoverished cities. To do so, he pioneered the use of health care data to first identify patients who were frequent utilizers of the city’s medical system. Based on data of discharged patients, he created a searchable database to geographically map medical hotspots in Camden. Armed with this data, he then assembled an interdisciplinary team of physicians, health coaches, social workers,

mental health counselors, nurses, and community health workers to address the multitude of challenges affected these super-utilizers.

Dr. Brenner’s care team, called the Camden Coalition, was a great success. In 2011, Atul Gawande, MD, MPH, reported in a *New Yorker* magazine article that the coalition was credited with a 40% reduction in ED visits and a 56% reduction in total hospital bills among the program’s target population. Hospital costs fell from \$1.2 million per month to a little over \$500,000.<sup>2</sup> In order to build on the initial success of this treatment model, Dr. Brenner received a MacArthur “genius” grant in 2013. Dr. Brenner and UnitedHealthcare entered into a 3 year/\$15 million partnership in 2017 to further refine, replicate, and improve the results of the coalition.<sup>3</sup>

The success of the Camden Coalition

**We must focus on conditions that drive over-utilization (and sometimes under-utilization) by our sickest, most vulnerable patients. This concept is only in its infancy, and it is up to our generation to be innovators.**



has led many health care systems throughout the United States to emulate the hotspotting model and develop their own programs to address the needs of super-utilizer populations. While the definition of a super-utilizer varies from organization to organization, at a minimum, it encompasses an individual with more than 5 ED visits or 2 inpatient visits within a 6-month period. Once this cohort has been identified, the real challenge lies in coordinating an interdisciplinary team of health care professionals and community groups to successfully engage with patients.

### Why Should we Care?

Emergency physicians are on the front line of health care. We care for all-comers, with the motto any patient, any need, anytime, anywhere. All of us know the “regulars,” many of whom are plagued by more than chronic health conditions. To provide meaningful care to these patients, it’s important to understand the daunting complexities of our health care system and the societal challenges that lead to ineffective


treatment and suboptimal outcomes. It is our job to advocate for these patients and to participate in the interdisciplinary health care model that is taking shape throughout the nation.

As an intern for the Camden Coalition during college, working in Cooper Medical School’s free clinic, and now as the resident advisor to LSU New Orleans’ own hotspotting group, I have witnessed the barriers to care that many patients confront. Take, for example, the type 2 diabetic who repeatedly presents with hyperglycemia or in DKA. My formal training has prepared me to diagnose disease and to devise a treatment plan. But that approach frequently results in missing a key obstacle to improving the health of the most vulnerable patients. The type 2 diabetic may not be *choosing* to neglect his or her own care, but rather may be encountering numerous barriers to symptom control that cannot be parsed out with a simple medical exam. Therefore, it is imperative for us to learn ways to help patients navigate the barriers to effective care.

### What is the Future?

As our health care system is continually in flux, we must be vigilant in our study of the science of health care delivery. Our generational challenges will not be limited to identifying new approaches to ailments walking through the ED doors. Instead, we must also focus on conditions that drive over-utilization (and sometimes under-utilization) by our sickest, most vulnerable patient populations. This concept is only in its infancy, and it is up to our generation of health care professionals to be innovators and advocates.

Hotspotting is only one approach and most of us do not have access to a team of professionals like that assembled by Dr. Brenner. Yet we can all work with our colleagues—social workers, dietitians, community health advocates, and mental health workers—to create a systematic approach to health care outcomes that serves both the medical and social needs of our patients. We must redefine the scope of health care delivery and ensure that it meets the diverse needs of the patients we are privileged to serve. ★



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# Developing a Career in Clinical Informatics



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**T**raining in clinical informatics empowers physicians to apply information technology in a systemic way that promotes efficiency, patient safety, and the improvement of health care systems. However, many people are still wondering what a career as a Clinical Informaticist looks like. We interviewed ACEP Board member and Indiana University School of Medicine Clinical Informatics Fellowship Director John T. Finnell, MD, MSC, FACEP, FACMI, to explore career prospects and seek practical advice for those interested in pursuing a fellowship in clinical informatics.

### What is your background, and how did you develop an interest in clinical informatics?

I was frustrated at how inefficient I was in our health care system. As a medical student, we had to hand-write discharge instructions for all of our patients in the ED. I frequently found myself frustrated that I couldn't reliably complete these for every patient. So as a student project, I developed a template for patients with head injuries, lacerations, etc. This allowed other providers to provide the same content to patients being discharged from the department. Throughout my residency, I developed tools to make me more efficient as a resident. During my ICU rotation, I built a templated note, so that when I was rounding at 4 am, I just had to fill in the fields for each patient. Even as faculty, I found similar inefficiencies. I didn't realize there was a field of clinical informatics until one of my residents mentioned it. I completed the U.S. National Library of Medicine fellowship

at Regenstrief Institute from 2002-2005. Since that time, I've been the program director for the Training in Biomedical Informatics (T-15) program, as well as now the program director for the clinical informatics program.

### How would you define the field of clinical informatics?

The field of clinical informatics is pretty broad overall. The primary focus of the fellowship is to train physicians to become leaders in the health care system, focusing on operations and IT. The goal of clinical informatics is to make systems smarter and more efficient for the entire health care system – from patients to providers. Our systems need to be designed to be intuitive, not interruptive, to maximize any clinical benefit.

### What does a fellowship in clinical informatics look like?

Many programs utilize the didactic program at Oregon Health and Science University (OHSU) as part of their educational program. Our fellows are eligible to get a certificate through OHSU for completing their coursework. The additional win is that fellows are often in the same class and are collaborating on projects across the country. This is an excellent example of making our educational system more efficient. Not every informatics program in the country (and there are 30+ programs now) needs to talk about data security. As part of their rotations, most fellows are paired with the Chief Medical Informatics Officer of the health care system, or with part of their team. Many will shadow and participate in the meetings and projects being developed. In our program, our fellows continue to work clinically as well. This

allows them to continue to develop their clinical skill set, as well as understand the nuances of the information system they are building. Finally, one of the key things that an applicant should look at is how the fellowships are funded. There are a variety of models, from external funding (from companies), internal funding (from the Dean's office), to our model where fellows work part-time clinically.

### What does a career in clinical informatics look like?

This is a great question, and timely as well, as American Medical Informatics Association is currently looking into this. The primary focus is for graduates to be involved in some aspect of the health care system. Whether this is at the department, hospital, or system level would depend on their needs. Many fellows go into leadership positions within the health care system. This doesn't mean that fellows can't participate with vendors of systems, ie, working for Epic or Cerner — or related startup companies. Our fellows frequently use their elective time to work with some of these new and upcoming companies.

### How do you blend your EM training with clinical informatics?

When I was a medical student, we didn't have any outside clinical data. If patients did have external data, we would frequently repeat the tests. As time has passed and there is more information sharing, there is often more data than we can consume during a typical visit. This leads me to some of the fun projects I've been fortunate enough to be involved with. My most recent activity revolves around bringing relevant clinical data to the forefront,

depending upon the patient's chief complaint. So, in patients with chest pain, we would bring forward the most recent EKG, stress test, cardiac catheterization report, and cardiology note. Working with medical students over the past decade has demonstrated that with each chief complaint, there's often a set of clinical data providers would like to have. It's fun to imagine how we can make our practice more enjoyable.

Another project involves linking our prescription drug monitoring program (PDMP) with our health information exchange. Every time a patient presents to the ED, there is a new PDMP report available in the system, allowing smooth and easy access.

### **For those who do not have an informatics program at their residency, how does one learn more about the field?**

If folks are interested in clinical informatics, they should consider joining, or at least looking at, AMIA. AMIA is ... the parent organization for all of health care and clinical informatics.

There is a fall symposium where many, if not all, of the training programs are present. This would give a resident an excellent chance to talk to the various training programs and find out which of the programs may be a better fit for them. There are opportunities to do electives, although these can be somewhat challenging with existing GME rules. Another option would be for students/residents to participate in an informatics project while they're doing their emergency medicine elective.

### **Since the practice pathway is closing, which types of informatics fellowships can I apply to?**

First, the applicant should know they can be hosted by one of many primary specialties. The host department is typically more of an administrative relationship, and should not impact the educational program. Keep in mind that some programs only accept certain specialties within their fellowship. For example, some may not take a pathologist as a clinical informatics fellow. So, it would be good advice to check with

the fellowship website or contact the fellowship directly to see if any of these programs would not accept in emergency medicine graduate. The other nuance of this administrative relationship is that when the primary specialty is being reviewed, all fellowships tied to the primary specialty are reviewed at the same time. If any of the fellowships have significant citations, this can impact the primary/hosting specialty.

### **Anything else you would like EM residents to know about the field of clinical informatics?**

Whether you are going into academics or private practice, you should find a niche, something that keeps you involved and interested. There are many choices to choose from, and clinical informatics is just one of those. We often have applicants to our program, that were initially not aware of opportunity to pursue clinical informatics as a formal discipline. Lastly, I would be happy to chat with anyone interested in learning more about the specialty or like to spend time with us here at Indiana University. ★



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# Making Sense of Graduate Medical Education Funding



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**G**raduate medical education (GME) funding does not get the same news coverage as other topics in healthcare, but that doesn't make it any less important. GME has a long and storied history in our country and has consistently been a top priority of many physician representation groups including the American Medical Association, American Osteopathic Association, American Academy of Medical Colleges, and many more. As young physicians, we should not only strive to learn about GME but also be its main advocates.

## What Is GME and How Is It Funded?

GME encompasses all the training medical students receive after graduation in order to be a practicing physician. In simple terms, GME means residency and fellowship. This is an easy distinction for us to make but, to the general public, this is often a point of confusion.

GME is funded by multiple mechanisms, including federal, state, and private entities, with the federal government being by far the largest

contributor to GME funding. The mechanism by which federal funds flow is through Direct GME (DGME) and Indirect Medical Education (IME). Both DGME and IME payments are controlled by Medicare, which means the Centers for Medicare and Medicaid Services (CMS) essentially controls GME funding.

DGME helps to pay for direct teaching costs (eg, resident salaries and benefits, faculty). IME funds are more nuanced. This funding covers teaching hospital compensation, additional residency support staff, updated technology, and handling a population that tends to be sicker and of lower socioeconomic status. For example, a typical teaching hospital will have a trauma unit and/or Neonatal Intensive Care Unit. These units generally lose money for the hospital since they are so specialized. However, these serve a vulnerable population and are valuable learning experiences during residency training, so CMS supports these specialty units with IME payments.<sup>1,2</sup> The amount of IME paid out is tied to the hospital's Medicare population served and to the size of a residency program. The amount of IME has been more than double the cost of DGME in recent years.<sup>3</sup>

## The History of GME Funding

GME funding has a long history that goes back to the early 1900s. Back then, training institutions and hospitals paid their own money to train residents. In 1965 when Congress created Medicare, they knew that an increase in health

coverage would require a concordant increase in physicians that could not be solely supported by private hospitals. Medicare funds were allocated to help pay for GME until other sources of funding could be identified. A better model was never agreed upon and Medicare has continued to provide GME funding since.

For the next three decades, CMS did their best to fund GME without any strict rules or structure in place. CMS had no spending limits for GME spending, until the Balanced Budget Act of 1997. With that act, Congress capped the number of residents that would be paid for under DGME funding.<sup>4</sup> Multiple presidential budgets have come out since then, some asking for increasing GME funding and some asking to limit GME funding. However, no changes have been made to this cap set in 1997.<sup>1,2</sup> Medical schools, who do not rely on a limited funding stream, have since increased their matriculation rates which has created a bottle-neck effect that worsens each year.

## Why Increased GME Funding Is Needed

The Match becomes more competitive each year, which can be attributed in large part to the limited number of residency positions available. Since the 1970s, the number of students in The Match has surpassed the number PGY-1 positions, a trend that shows no signs of slowing down.<sup>5</sup> By increasing funding for GME, we are effectively increasing this PGY-1 position total and ensuring that



medical students have the opportunity to continue their training.

GME funding also helps to support teaching hospitals which provide almost half of all charity care in our country. They also provide highly specialized care for rare diseases (eg, Neonatal ICUs, Pediatric ICUs, Burn Units, Trauma ICUs, AIDS services).<sup>5</sup>

Finally, when talking about GME funding it is impossible not to talk about the big looming issue of physician workforce. The United States has a predicted physician shortage of nearly 122,000 by the year 2032, a prediction that has only worsened in past years. This physician shortage is predicted to be exacerbated by our nation's rapidly aging population, both on the supply and demand side. The U.S. Census Bureau predicts the population will grow by more than 10% by 2032, with those over age 65 increasing by 48%, which will greatly increase demand for healthcare professionals. The supply side of the physician workforce is also expected to worsen, with nearly one-third of practicing doctors turning 65 in the upcoming 10 years.<sup>6</sup> Having this physician group retirement coincide with a large increase in healthcare usage of an aging population is going to be a significant stressor to our already overloaded system. Funding GME means we can produce more doctors and help to solve this problem before it begins.

### The Potential Solutions

There have been many bills proposed ever since the 1997 Balanced Budget Act, but most have found it hard to gain traction in Congress. However, many believe we are coming to a tipping point and change is poised to happen soon.

The "Resident Physician Shortage Reduction Act of 2019" (S.348) is a bill that has been discussed among Congressional leadership for multiple years but has recently found new life. This bill, sponsored by Sen. Robert Menendez (D-NJ), would increase GME slots by 15,000 over a 5-year period. This increase is less than what is needed to adequately address the physician shortage but could be a catalyst for increasing residency spots, which have been stagnant for more than two decades.

The "Community and Public Health Programs Extension Act of 2019" (S.192) coming from Senator Lamar Alexander (R-TN) is another important bill gaining traction. The bill funds five important programs centered around public health, one of them being the Teaching Health Center Graduate Medical Education (THCGME) Program. This is one of the few opportunities to increase GME funding outside of direct Medicare-supported positions. The THCGME Program currently supports 728 residents and has the added benefit of prioritizing underserved populations.<sup>7</sup> The bill also further funds the National Health Service Corps (NHSC) which is an important program that allows physician's unique help with loan repayment if they practice in a physician shortage area.

The pushback that these bills, and many bills proposed in previous cycles, receive is largely due to their high fiscal note. There is an argument that GME funding is currently not proportioned correctly. In 2016, the Medicare Payment Advisory Commission (MedPAC) found that IME payments may be overestimating the indirect costs of residency training. By their estimates, IME expenditures should only be approximately 1/3 of their current amounts.<sup>8</sup> A solution that has been proposed several times is that funds may be spent more responsibly if DGME and IME were merged into one entity. However, this plan disincentivizes hospitals to invest in primary care and may reduce resident compensation.

Lastly, the ACGME has begun to recognize the crucial role that industry funded residency programs may play in the coming years, as continued Medicare funding is not a guarantee. Industries that have become "influential" sources of funding in the past 10 years include pharmaceuticals, medical device, and biotechnology companies. Although the ACGME promotes standards that require training institutions to monitor interactions between corporations and trainees, they cannot guarantee that industry funded programs will not affect clinical decision-making by residents funded under such programs.<sup>9</sup> EMRA recently passed a resolution to examine

the effects that corporate-sponsored EM residency programs may have on physicians in training.<sup>10</sup>

### How to Help

GME funding is a highly specific topic and is therefore not addressed by many other lobbying organizations. Residents and medical students, as the future of medicine, are some of the few advocates for this issue. Congress and multiple Presidential budgets have put GME on the chopping block in the past and medical advocacy offices across many specialties have had to fight hard to just maintain the current funding that is available. We are a small group advocating on a specific topic so persistence is key.

Fighting for GME funding consistently over a long period of time is the only way. Sending in letters and making phone calls to your representatives, setting up meetings with your members of Congress, and participating in or organizing a GME advocacy event are some ways you can have a strong impact. Sending in letters is a staple of advocacy efforts and has become easier with the use of the internet. By visiting <http://savegme.org/content/medical-professionals> you can find your representatives and send them prewritten messages on behalf of the AMA.<sup>11</sup> The AAMC also has multiple resources on GME funding,<sup>12</sup> specifically if you are looking to expand your knowledge on the details of funding, at <https://www.aamc.org/advocacy/gme>. Setting up meetings with your representatives and attending national and state advocacy events can make a huge impact on a representative's decision-making.

GME advocates cannot afford to take the foot off the gas even for a single Congressional cycle. If physicians and students fail to show up and fight for GME funding, then Congress will rightfully assume the issue is not important and can be sacrificed when the next budget season rolls around. Actively advocating for GME funding is the responsibility of all physicians, regardless of where they are in training, so the future of health care and safety of patients is protected. ★

# Beyond the Comfort Zone

Matthew Trifan, MD

Thomas Jefferson University Hospital

The clock is ticking. The number of days left in residency is dwindling. On the horizon awaits the holy grail of medicine: independence as an attending physician. It is the culmination of years of grueling effort. I have long dreamed of life as an attending—not simply for the better hours and salary, but for the freedom to exercise my own medical judgment.

Of course, this independence comes at a cost. As an attending, I will bear the full weight and responsibility of my patients' care. There will be no senior colleague to catch my mistakes. The buck stops with me.

This thought increasingly preoccupies me as the end of residency draws near. I find myself haunted by a single question.

*Am I ready?*

While I trust in my training, it's hard to shake off the anxiety of practicing alone. Emergency medicine residents are expected to master a dizzying array of medical and procedural skills before we “fly” as attendings. These include physical skills — like lumbar punctures, joint reductions, vaginal deliveries, surgical airways, and chest tubes — and a nearly-endless spectrum of medical pathology, from cardiac arrhythmias to strange and itchy rashes. It is a daunting skill-set to learn in just three years of residency.

I'm left wondering, who could *possibly* feel comfortable stepping into this field as a new attending?

Thinking back on my residency, though, I realize I have no reason to feel insecure. Hasn't all of residency been a continuous exercise in living outside my comfort zone? Beginning in my intern year, I faced a slew of skepticism from my patients about my age and inexperience. As a new resident, I remember how difficult it was to convince patients to let me perform procedures on them. When I reviewed the risks aloud—from collapsed lungs, to strokes, to possible death—I often found myself sweating alongside my patients. I was wracked with insecurity and paralyzed by my own empathy. I knew that if I were in their shoes, I wouldn't want a rookie doctor puncturing my spinal sac.

And yet, I survived.

I learned how to take a deep breath, steel my nerves, and get the job done. Yes, I made mistakes. And yes, I offered apologies. But I never lied. I never offered false assurances, and I never embellished my experience. I learned to be uncomfortable, to embrace uncertainty, in order to maintain my honesty.

Residency is designed this way. It is meant to push you beyond your comfort zone, knowing there is always a safety net beneath you. If you fail, there are more experienced hands who can finish the job.

Next year, though, that net vanishes for me. There will be no seasoned doctor to step in and rescue my difficult intubation; no grizzled clinician to recognize that my sweating patient is in a thyroid storm. It's just me. My mind. My hands. My gut.

That's why I feel a fire burning within me, urging me to grab every procedure and critical patient who comes my way. I am spurred on by my fear of inexperience, knowing that inexperience can kill patients. There is no shortcut.

These are my tools from residency. They have taught me that I don't need to feel *comfortable* to do my job. In fact, I've been thriving outside the comfort zone for years.

The clock is ticking. As graduation draws near, the same question haunts me with a singular obsession. *Am I ready?*

No, I'm not. I never will be. But I realize now, no one ever is. ★



## How to Be Ready to ‘Attend’

There are lessons, that I've learned from residency — from living beyond the comfort zone — that may help prepare for life as an attending physician.

### Don't Overreach

First, know your limitations, and practice what you know. Don't be cavalier about new procedures or new medications without the proper understanding for what you are doing.

### Don't Overlook

Know your resources. Know which pocket carries your critical medication list, and how to quickly troubleshoot those pediatric emergencies.

### Don't Be a Loner

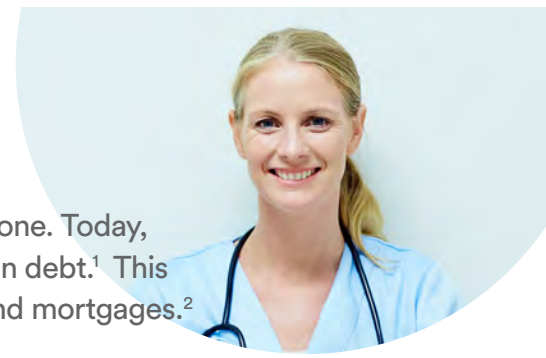
Trust your team and delegate tasks. Don't try to shoulder the entire department alone. The nurses, techs, and pharmacists around you are your greatest assets and your strongest allies.

### Don't Guess or Gamble

Ask for help when you need it. There is no shame in asking consultants, nurses, or even patients themselves to explain unfamiliar concepts to you. Don't be proud. Humility saves lives; hubris costs them.

### Don't Fear Uncertainty

Finally, and most importantly, don't be afraid to say, “I don't know.” Recognize the limits of your knowledge and cherish the ethos of honesty, even if it costs you your pride. Remember that patients don't expect us to be perfect. They expect us to be human and kind. Compassion, sincerity, and humor will save you from many embarrassing situations and keep you anchored in your humanity.



## A Guide to Student Loan Refinancing

If you're trying to figure out how to best manage student debt, you're not alone. Today, 44 million Americans collectively owe nearly 1.6 trillion dollars in student loan debt.<sup>1</sup> This makes student loan debt the second largest source of household debt behind mortgages.<sup>2</sup>

A big piece of that is made up of medical students – with 75% of medical students in the U.S. graduating with debt.<sup>3</sup> In fact, 51% of medical students that graduated with student loans in 2018 had loans of \$200,000 or more.<sup>3</sup>

Needless to say the burden of student debt can feel overwhelming – especially for physicians who have exceedingly high loans. But educating yourself on your options and planning accordingly can help ease some of that stress. In this article, we'll go through the different federal repayment options, as well as talk about student loan refinancing – which is what Laurel Road does and can be a very attractive option for physicians.

### Federal Repayment Options

Physicians with Federal student loans have a number of different repayment options at their disposal, including; direct consolidation, income-driven repayment and public service loan forgiveness.

#### DIRECT CONSOLIDATION

You have the option of consolidating individual federal loans into one loan from the government. The new loan will have a repayment term from 10-30 years and use the weighted average of the consolidated interest rates as the new fixed rate.

Since Direct Consolidation simply combines two or more loans into one loan with one weighted interest rate it does not usually offer any interest savings. Also, private student loans cannot be included.

#### INCOME-DRIVEN REPAYMENT (IDR)

IDR plans allow you to reduce monthly payments for federal loans according to your income—typically a portion of your discretionary income. Repayment periods generally range from 20 to 25 years.

Consider future earning potential when enrolling in IDR. While it might make sense during training, monthly payments will likely match those of standard repayment plans once practicing and earning a higher income, making refinancing an attractive option – as payment terms can be extended and/or lower rates can be obtained with refinancing.

#### PUBLIC SERVICE LOAN FORGIVENESS

Residents working in public or non-profit sector jobs can have loans forgiven after 10 years. If you are employed in certain public service jobs and have made at least 120 payments on your Direct Loans, the remaining balance may be forgiven.

For physicians, the potential savings from loan forgiveness should be balanced

against potential income lost from forgoing private sector employment.

### Student Loan Refinancing

Laurel Road refinances student loans by paying off a customer's current student loans and issuing them a new loan. With student loan refinancing you can refinance all or some of your federal and private student loans. Loan eligibility depends on lending criteria such as credit profile, monthly income, and monthly debt payments

When Laurel Road kicked off student loan refinancing in 2013, our mission was clear: to help qualified graduates reduce the burden of student loan debt. But in 2015, we discovered an underserved subset of that market – physicians in residency that still had to pay back their student loans, regardless of their salary.

We knew that during residency a doctor is only making a fraction of what they will be post-residency. This only makes student loan repayment more stressful as doctor's try to balance high student loan payments with a moderate resident or fellowship salary.

Our aim – help doctors in this sticky situation by giving them a low-fixed monthly repayment option while in residency. After the residency period

ends, their monthly payment will switch over to the Post-Residency Monthly Payment they were quoted at the time of refinancing, based on the rate they were approved for when taking out the loan.

Regardless of whether you're a resident or practicing physician, student loan refinancing allows you to create a plan that fits your circumstance. This provides the opportunity to do one or more of the following:

- Lower interest rate(s)
- Pay off loans faster
- Lower monthly payments
- Move from a fixed rate to a variable rate (or vice versa)
- Reduce number of loans in repayment

Please be aware that you may lose certain Federal benefits by refinancing your Federal Student loans.

There is no one size fits all solution for tackling student loan debt. But knowing your options is the first step in towards making a strategic plan to pay your student loan debt.

As an EMRA member or alumni, you can get a 0.25% rate discount when refinancing.<sup>4</sup> To apply, visit [laurelroad.com/EMRA](http://laurelroad.com/EMRA) and see personalized rates in under five minutes.

1. *Student Loans Owned and Securitized, Outstanding*, Federal Reserve Bank of St. Louis

2. *Federal Reserve Board*, 2016

3. *Medical Student Education: Debt, Costs, and Loan Repayment Fact Card*, AAMC, October 2018

4. The 0.25% EMRA member rate discount is offered for student loan applications from EMRA members in good standing. The rate discount will end if EMRA notifies Laurel Road that borrower is no longer in good standing. Offer cannot be combined with other Laurel Road offers, except any discount for making automatic payments. The partner discount will not reduce the monthly payment; instead, the discount is applied to the principal to help pay the loan down faster





# Insights from ACEP/CORD Resident Teaching Fellowship

Editor's note: The ACEP/CORD Teaching Fellowship is an annual offering. Learn more about the opportunity through firsthand thoughts from attendee Breanne Jaqua.

**Breanne Jaqua, DO, MPH**  
 Mercy St. Vincent Medical Center  
 @BreanneJaqua

**T**his was the second year of the 3-day ACEP/CORD Resident Teaching Fellowship (RTF) hosted in Dallas.

For emergency medicine residents interested in fellowship, teaching, and/or an academic career, it was a singular learning and networking opportunity.

The Resident Teaching Fellowship ran concurrently with the fall session of the ACEP/CORD junior faculty teaching fellowship, so residents could ask questions of academic faculty in all stages of their career, and network with future colleagues.

The resident teaching fellowship, unlike the junior faculty course, does not have a capstone or longitudinal project. Rather, residents are encouraged to simply come as they are, with an open and inquisitive mindset. Mentorship was a very important aspect of this experience; most residents (myself included) left with at least one new mentor to guide them along their journey in medicine. This course is

a wonderful way to step back, press pause for a few days, and enjoy the collaboration of similarly engaged and motivated colleagues.

The curriculum of the RTF can be divided into 5 broad categories: a day in the life of an academic, job preparation, teaching tools, leadership, and pearls of wisdom. There was too much content to mention every lecture, but here are some pearls and highlights.

## **A Day in the Life of an Academic**

The conference began with Saadia Akhtar, MD, FACEP, and Flavia Nobay, MD, presenting on "What to Expect in an Academic Career- Navigating the Day to Day." This was followed by a panel discussion of medical education, which provided both short-term and long-term insight into a career in academic medicine. At one end of the spectrum of panelists was Guy Carmelli, MD, who just finished his medical education fellowship and master's degree in education; he is currently working as an academic attending. On the other end of

the spectrum was Dr. Nobay and Sandy Schneider, MD. Dr. Nobay is a former EM program director and currently works as an Associate Dean for Admissions at the University of Rochester. Dr. Schneider is the Associate Executive Director of Clinical Affairs at ACEP. Annahieta Kalantari, DO, FACEP, is midcareer, and working as an associate program director at Penn State's Hershey Medical Center. The discussion was robust, and among the many insights provided one stuck with me: Most panelists ended up in unexpected geographic regions during their journey in academics. This was a great reminder to keep an open mind when considering new opportunities.

## **CV Keys**

One of the most important parts of this conference was the information and feedback provided on CVs. Attendees were asked to update their CVs prior to the conference, and bring them for review. On the first day, Dr. Akhtar gave a presentation on CV do's and don'ts (*FYI, serif font is an absolute no-no*),

which informed small-group, round-table style feedback with faculty on specific CV questions.

A key take-away was to treat your CV like a living document, and to update it frequently (*I update mine once a month*). Residents thinking about a career in academics should consider adding an “educational innovations” section to their CV to highlight accomplishments and projects that might not be captured elsewhere. Any blog posts or digital media productions like podcasts can and should be listed under “online publications” and “digital scholarship,” respectively.

It’s also imperative to note on your CV if any of your publications are peer reviewed, as this can be pivotal for promotions and job applications. Another important section to include is “(post-graduate) professional development” — a great way to show continued learning and involvement (ie, attending an advanced ultrasound course, leadership seminars, a national FEMA training course, etc.).

### Teaching Tools

For participants looking to improve as teachers or bring back pearls for their programs, there was an impressive range of information. Christina Shenvi, MD, PhD, FACEP, addressed the nuances of adult learning and principle learning theories. For individuals planning on a career in academics, this information was fundamental.

Dr. Kalantari introduced a teaching tool called StatPEARLS for simulation debriefing. The StatPEARLS method has 5 steps: setting the scene, reactions, description, analysis, and summary. Despite being a PGY-3, no one has ever asked me how I responded emotionally to a simulation experience, but this is a key component to starting the debrief conversation with StatPEARLS (the reaction step). This is a powerful part of debriefing which I think is often overlooked but codified in this tool. Another key part of the debrief conversation is summarizing, and seeing if everyone was on the same page during the simulation. I used this tool the first week back at my program and it was amazing! Also, I would be remiss if I didn’t mention that before any simulation scenario, you must pre-brief!! Just imagine someone

preparing to do a trust fall, but leaning the wrong way at the moment of truth. Think of this image, and you’ll never forget a pre-brief again! (Thank you, Dr. Kalantari, for that visual aid!)

### Leadership

Dr. Akhtar opened Day 2 with a lecture on the “7 Traits of Highly Effective Academic Leaders,” which was informed by Covey’s “The 7 Habits of Highly Effective People.” My favorite take-away from this lecture was “seek first to understand, then to be understood.” When I am in meetings or discussing a project I am passionate about, my enthusiasm sometimes gets in the way, and I end up talking more than anyone else in the room (to the subsequent horror of my reflective introvert self). This was a great reminder to listen first and foremost.

Mary Jo Wagner, MD, FACEP, presented on opportunities in organized medicine and also gave an overview of teaching fellowships.

Lastly, Jason Wagner, MD, FACEP, challenged participants to take “stacked breaths” whenever they are in a high stress scenario. He noted that when you feel stressed (like doing a central line for the first time or performing a difficult intubation) one of the first things to be lost is fine motor control, which you desperately need. By taking stacked breaths, you can quickly regain control of your nerves. To take a stacked breath, take a deep breath in, then breathe in a little more, then a little more, and hold it for a few seconds. I have found this to work not only in the ED, but in any high stress situation.

### Pearls of Wisdom

Dr. Nobay gave a series of lectures that required a category all their own. Her first lecture introduced the concept of organizational strategy, or advanced time management. She discussed the difference (and importance) of both deep and shallow work, and how your schedule should be a reflection of your values, not the other way around. I have always prided myself on being an excellent time manager, but Dr. Nobay took this to a new level: radical scheduling. I have never before so clearly understood how I am spending my time. I was shocked by how little free time I have

in a week, and this revelation helped me prioritize what is most important. Looking to read more on this topic? Dr. Nobay recommended “Getting Things Done: The Art of Stress-Free Productivity” by David Allen and “Deep Work: Rules for Focused Success in a Distracted World” by Cal Newport.

Dr. Nobay also presented on generational differences, and how communication among people from different generations can be strained by subconscious preferences and experiences. For instance, Baby Boomers often prefer in person, face-to-face communication, whereas Generation Yers prefer texts and Internet platforms like Slack. The take-home message was the preferences and values of people from different generations matter, and can lead to synergy or conflict depending on the approach.

Understanding your audience can help you be a better communicator, which is key as an educator. Dr. Nobay explained the variations in communication styles based on personality types. For instance, some people respond best to big-picture thinking and questions, whereas others need specific details and examples. Other people look to connect on an emotional level and respond best to anecdotes and stories.

### Conclusion

The RTF concluded with break-out sessions where participants could delve deeper in to a specific topic including CVs, resilience, building an online academic community, or organizational strategies (radical scheduling).

This was hands-down one of the best experiences I have had during residency, and I recommend it to any resident interested in pursuing a career in academics, looking to be a better educator, or looking for tools to take home to a residency program. You are sure to leave this experience feeling energized, with new friends and mentors, and with tangible inspirations to share!

*For more information, visit <https://www.acep.org/teaching-fellowship>. If you are interested in taking the course, join the interest list and be one of the first to know when registration opens. The next offering of the Resident’s Teaching Fellowship will be Aug 6 – 8, 2020. ★*



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## “In My Dreams, I’m Still There”

**Emergency medicine bid farewell to a founding father in November with the passing of Peter Rosen, MD.**

In addition to being integral to the creation of EM as a specialty, Dr. Rosen worked tirelessly to establish educational programs and cement the future of emergency medicine. His legacy also includes writing and sustaining one of the go-to guides for emergency care, Rosen’s *Emergency Medicine: Concepts and Clinical Practice*.

Even at age 84, the practice of emergency medicine was never far from Dr. Rosen’s mind. His closing thought from ACEP’s 50th anniversary book, *Bring ‘Em All: “But I dream about the emergency room. In my dreams, I’m still there. I’ll always be there.”* Hear from Dr. Rosen in his own words in 24/7/365: *The Evolution of Emergency Medicine* (<http://ow.ly/4quh50xacv5>) and *Meet The Founders: A Panel of Emergency Medicine’s Heroes* (<https://vimeo.com/372746610>). ★

## Join Us in New York City!

EMRA will host a full range of activities in conjunction with *CORD Academic Assembly* this spring. **Make arrangements now to join us March 7-11 in New York City.** Plans are still underway, but some highlights include:

- **March 7 (am):** EMRA is hosting its Spring Medical Student Forum at the Westin Time Square. We will offer top-notch programming in collaboration with AIINYCEM and NY ACEP. Check the “Events and Activities” section of [emra.org](http://emra.org) for Medical Student Forum registration details.
- **March 7 (pm):** EMRA committees are at it again. Spend the afternoon with birds of a feather, helping drive the specialty forward through workshops, panel discussions, and more.
- **March 8:** Leadership Academy, EMRA Public Hearing & Resolution Review, EMRA Quiz Show
- **March 9:** EMRA Representative Council Meeting & Town Hall

EMRA events are free and do not require *CORD Academic Assembly* registration. However, we encourage full participation in *Academic Assembly*; register for it at [cordem.org](http://cordem.org). ★

## EMF Grants Up for Grabs

The Emergency Medicine Foundation (EMF) has announced its 2020-2021 research grant opportunities. **Review the request for proposals and apply for funding by Feb. 7, by visiting [emfoundation.org/grants](http://emfoundation.org/grants).**

In addition to EMF partnered grants, 4 new directed research grants are available:

- Nasal High Flow Therapy for Respiratory Compromised Patients in the ED
- Reducing Burnout through ED Design
- Better Prescribing Better Treatment Program
- Diagnostics Research

For questions, contact Cynthia Singh at [csingh@acep.org](mailto:csingh@acep.org) or 800-798-1822 ext. 3217. ★

## EMRA Awards Open for Nominations

EMRA’s spring cycle of awards, scholarships, and grants is now open for nominations! The deadline is Jan. 1, so you only have a couple of weeks to make sure the best and brightest people in the specialty are recognized.

We will honor the most outstanding applicants in medical student, resident, fellow, and faculty categories. Tens of thousands of dollars in travel scholarships and research grants will also be distributed, and professional development course tuitions will be earmarked for the most deserving candidates.

You must apply to be considered! Visit [emra.org/awards](http://emra.org/awards) to learn more and apply by Jan. 1. ★



## The Soundtrack of EM

As EMRA wraps up its 45 Anniversary Year looking ahead to a bright future, one of the 45 Under 45 Top Influencers in Emergency Medicine has provided a soundtrack — and you need to hear it. Cleavon MD’s Tribute to EMRA’s 45 Under 45 not only highlights individual accomplishments but also — and most important — celebrates the work still being done to make emergency medicine the best specialty it can be. Visit [vimeo.com/368016816](http://vimeo.com/368016816) to get excited and inspired! ★



## SmugMug: You Need This

**Did you know EMRA creates free photo galleries of all our highlights?**

Visit [emra.smugmug.com](http://emra.smugmug.com) to see the scenes from our competitions, meetings, awards ceremonies, and more! You'll see how we've grown over the years, what we're doing, and who's pitching in to make EMRA the vibrant family it is!

This year, we're offering individual galleries to show you the incredible events our EMRA committees hosted at ACEP19 — everything from a pediatric airway challenge to a groundbreaking diversity and inclusion panel discussion. ★

## Help Stop ED Violence

During ACEP19 in Denver, ACEP officially announced “No Silence on ED Violence,” a new joint campaign with the Emergency Nurses Association to tackle the growing epidemic of violence against caretakers inside the ED. This collaborative effort is designed to support, empower and provide the resources that EM physicians and nurses need to improve safety at their workplace while engaging the public at large to take action to address this crisis.

View resources and learn how you can help the cause by sharing your personal stories at [stopEDviolence.org](http://stopEDviolence.org). ★

## ACEP Benefit Offers Free Counseling, Legal Assistance

ACEP's new Wellness & Assistance Program was launched during ACEP19 in Denver. This program offers ACEP members exclusive access to 3 free counseling or wellness sessions. Support is available 24/7, and you can conduct your sessions over the phone, face-to-face, via text message, or through an online chat service — whatever works best for you! The service also includes 30-minute consultations for individual legal/financial matters. Learn more about this new benefit at [acep.org/support](http://acep.org/support). ★



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# Leadership Academy Accepting Applications

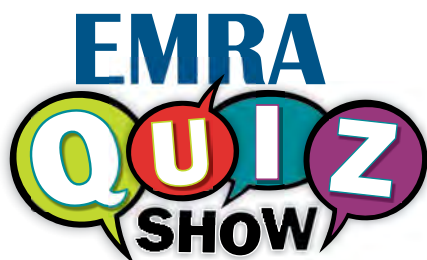
The EMRA Leadership Academy is accepting applications until Dec. 31. This yearlong professional development program prepares you for decision-making roles in organized medicine, academic medicine, community medicine — and any other pursuit. Learn practical skills like how to run a professional meeting or how to interpret an institution's financial sheets. Even more important, enhance your soft skills: understand how to handle conflict within a team, how to communicate effectively across many audiences, and more.

Visit [leadersacademy.secure-platform.com/a](https://leadersacademy.secure-platform.com/a) to learn more and sign up. ★

# EMRA RepCo Resolutions Due Jan. 24

EMRA's spring meeting of the Representative Council, held in conjunction with CORD Academic Assembly in New York City, is March 9. This means **resolutions are due Jan. 24!** Time to get your policy brain on. EMRA members are encouraged to submit resolutions on any topic pertaining to EM residency or the practice of emergency medicine. For step-by-step instructions and a sample resolution form, search "Representative Council" at [emra.org](https://emra.org).

**SPECIAL NOTE:** We want every program to vote! Get your program representative ready for the meeting on March 9. Attend CORD Academic Assembly and participate in-person, or tune in to Virtual RepCo and vote remotely. Either way, weigh in! ★



## Calling All Quiz Show Teams!

Now's the time to get your name in the hat to compete in the 2020 EMRA Quiz Show, sponsored by Rosh Review. The event takes place Sunday, March 8, in conjunction with CORD Academic Assembly in New York City. Register your team now at <https://www.surveymonkey.com/r/NFCSDHC>. We'll hold a lottery Jan. 2 to pick our competitors! ★



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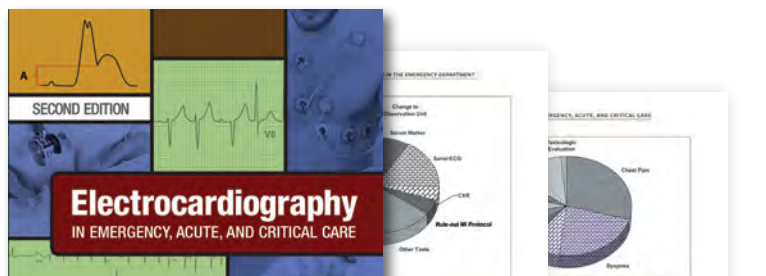
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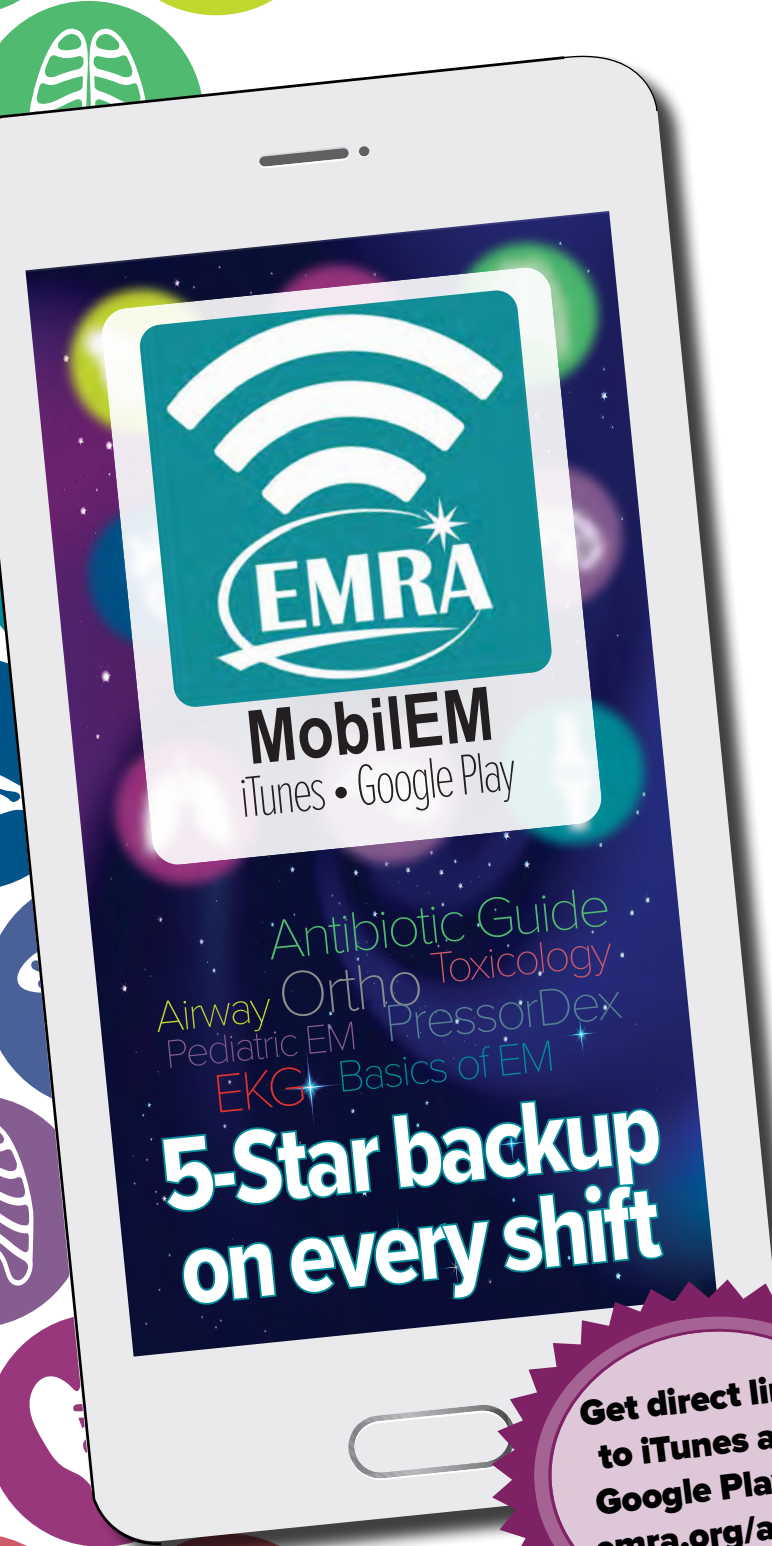
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# ECG Challenge

**Ben Flitter, MD**

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**Christopher Willoughby, MD**

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**Annelies De Wulf, MD, MS, MPH**

Assistant Professor of Emergency Medicine  
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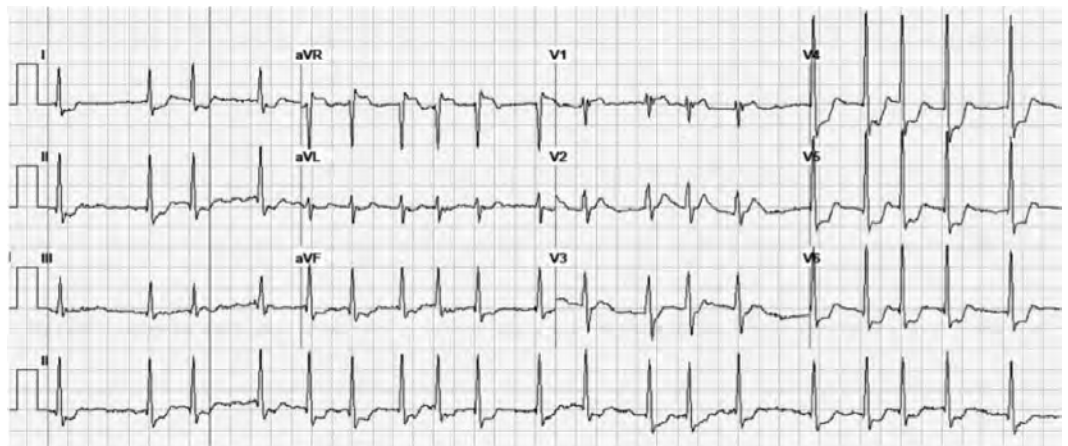
**Jeremy Berberian, MD**

Associate Director of Resident Education  
ChristianaCare  
@jgberberian

**CASE.** A 53-year-old male with unknown past medical history presents by EMS after a syncopal episode, acute shortness of breath, chest pain, and altered mental status. His initial vital signs are notable for hypoxia and hypotension.

**What is your interpretation of the following ECG?**

**See the ANSWER on page 44**



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\*Emergency medicine resident or medical student who contributes \$120 annually.



# ECG Challenge

## STE in aVR

The EKG shows atrial fibrillation with RVR at 115 bpm, ST elevations in aVR and V1, and ST depressions in I, aVL, II, aVF, V3, V4, V5, and V6. Unfortunately, there were no prior EKGs for comparison.

This pattern of STE in aVR and V1 with diffuse STD can be seen with the following: left main coronary artery (LMCA), proximal left anterior descending artery (LAD) insufficiency, diffuse subendocardial injury, and non-ACS causes such as right ventricular strain. It is important to determine the cause of this EKG pattern as emergent interventions may be indicated, such as PCI, CABG, or thrombolytics. Given the patient's hypotension and hypoxia, the differential included ischemia of the inferior, anterolateral, basal septum regions or massive pulmonary embolism (PE) causing right heart strain.

While PE was strongly considered based on the patient's history and vital signs, there are EKG features that argue for and against this diagnosis. Findings that could indicate RV strain or infarct include STE in V1 which is a rightward facing lead and the only standard EKG lead that is a direct reflection of the right ventricle. Additionally, STE in aVR, RBBB, and atrial fibrillation could all be explained by right-sided pressure overload. However, findings arguing against RV strain include a normal axis, neither significant STE or STD in lead III (which is the most rightward facing lead other than aVR), STE in aVR > V1, and lack of more pronounced ST-T wave changes in the anterior leads.

## LEARNING POINTS

### ST Elevation in aVR

#### General Features

- STE > 1 mm (0.1 mV) in aVR +/- V1, typically accompanied by diffuse STD

#### EKG Features

- aVR is most electrically opposite from II and V5
- Views the right upper heart, including the RV outflow tract and basal septum<sup>1</sup>

#### Clinical Significance

- Can be seen with triple vessel disease or insufficiency of the LAD or LMCA
  - STE in aVR > V1 suggests LMCA insufficiency, and higher STE predicts higher mortality<sup>2,7</sup>
  - Widespread inferolateral STD with STE in aVR can be seen with acute occlusion of the LAD or LMCA, and can be considered a "STEMI Equivalent" in the right clinical scenario<sup>7</sup>
  - STE > 0.05 mV in aVR has sensitivity of 68-91% and specificity of 73-80% for LMCA involvement<sup>6</sup>
  - STE in aVR > 0.1 mV is associated with an in-hospital death rate of 19.4% compared to 1.3% without elevation in this lead (odds ratio = 6.6)<sup>5</sup>

- STE in aVR can be observed in patients with right heart strain secondary to acute PE
  - STE in aVR can be a poor prognostic indicator in PE and more often presents with systolic blood pressure < 90 mmHg (27% vs 10%,  $p < 0.001$ )<sup>8</sup>
  - In one study, 33.3% of patients with STE in aVR vs. 13.1% of those without died during hospitalization. In regard to hospital mortality, STE aVR had a low sensitivity of 25.8%, but high specificity of 90.5%.<sup>9</sup>
- STE in aVR can also indicate diffuse subendocardial ischemia, as O<sub>2</sub> supply is not meeting demand. Other non-ACS causes include severe anemia, GI hemorrhage, or thoracic aortic dissection.
- Other instances where aVR may be helpful:<sup>7</sup>
  - Posterior wall STEMI in patients with severe multivessel coronary artery disease
  - Limb lead reversal – as seen by reversal of P-waves, QRS, T-waves in I and aVR
  - Pericarditis
  - Tall R-wave in aVR can suggest sodium channel blocker poisoning
  - Help differentiate AVNRT from AVRT
  - Detecting inverted P-waves and AV-dissociation in aVR confirming the diagnosis of ventricular tachycardia

## Case Conclusion

Cardiology was emergently consulted for possible STEMI. Based on bedside US that showed enlarged RV and dilated IVC, the cardiology team felt that right heart strain and endocardial injury were driving the EKG findings and recommended a CT PE study, which showed bilateral large PEs. The STD were likely due to LV subendocardial injury from hypoxemia and hypotension, the STE in aVR and V1 from RV transmural ischemia from the outflow tract obstruction, and the isoelectric ST segment in lead III from the summation of the STE and STD. tPA was administered after which the patient's hypotension, hypoxia, and altered mental status all resolved. He was admitted to the Medical ICU and subsequent formal TTE showed normal LV function. He was discharged 4 days later.

**Final Diagnosis:** Acute Saddle Pulmonary Embolism. ★



# Board Review Questions



**PEER (Physician's Evaluation and Educational Review in Emergency Medicine) is ACEP's gold standard in self-assessment and educational review.**

**For complete answers and explanations, visit the Board Review Questions page at [emresident.org](http://emresident.org), under "Test Your Knowledge" at [emresident.org](http://emresident.org)**

**Order PEER at [acep.org/peer](http://acep.org/peer)**

1. A 19-year-old woman presents with pain and decreased hearing in her right ear since the night before. Her ear is tender to palpation, especially at the tragus. The canal is erythematous, and the tympanic membrane, although difficult to visualize fully, appears normal. What is the best treatment for this condition?
  - A. Oral beta-lactam antibiotics
  - B. Oral corticosteroids and acyclovir
  - C. Surgical debridement
  - D. Topical corticosteroid and antibiotic solution
2. A 24-year-old black man presents with a mild headache. He describes it as dull, on both sides of his head, and in the front. When asked if he feels sensitive to light or sound, he says no. His vital signs include BP 185/100, P 88, R 14, and T 37°C (98.6°F). He has no chronic medical problems and takes no medications or recreational drugs; he does not have a primary care physician. A physical examination reveals normal mental status; the findings of ophthalmoscopic, neurologic, cardiac, and pulmonary examinations are normal. After a period of monitoring, his blood pressure is 180/105. What is the best course of action?
  - A. Admit the patient to a monitored acute care unit in the hospital for treatment
  - B. Give prochlorperazine and diphenhydramine and then discharge him when the pain resolves
  - C. Order a basic metabolic panel, consider starting hydrochlorothiazide, and arrange for outpatient follow-up
  - D. Order laboratory testing, including a CBC, basic metabolic panel, and urinalysis
3. Which therapeutic intervention has been shown to decrease mortality rates for acute respiratory distress syndrome?
  - A. Broad-spectrum antibiotics
  - B. Low-tidal-volume mechanical ventilation
  - C. Packed RBC transfusion
  - D. Prophylactic methylprednisolone
4. An accidental ingestion of which single pill by a 1-year-old (weight 10 kg) is potentially life-threatening?
  - A. Acetaminophen 500 mg
  - B. Aspirin 325 mg
  - C. Ferrous sulfate 325 mg
  - D. Glipizide 5 mg
5. A 20-year-old man presents with a gunshot wound to the right chest. He is awake and alert. His vital signs are BP 102/67, P 128, and RR 40. Bilateral breath sounds are present but diminished on the right. His neck veins are flat, and his trachea is midline. A supine chest x-ray demonstrates diffuse haziness of the right lung field, a normal mediastinum, and visible costophrenic angles. What is the appropriate next step?
  - A. Order a chest CT with IV contrast
  - B. Place a large-bore thoracostomy tube
  - C. Send the patient to the OR for a thoracotomy
  - D. Transfuse type-specific packed RBCs ★

1. D; 2. C; 3. B; 4. D; 5. B  
ANSWERS

# EM Resident

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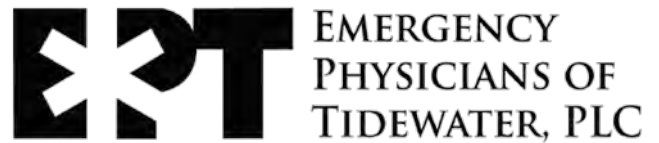
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**FOR MORE INFORMATION PLEASE CONTACT:**  
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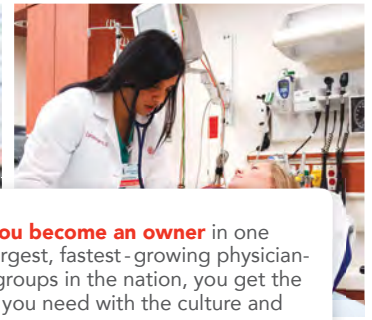
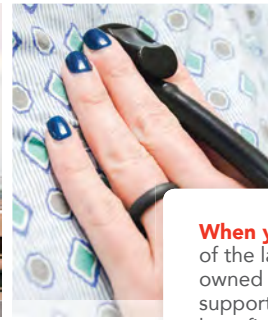
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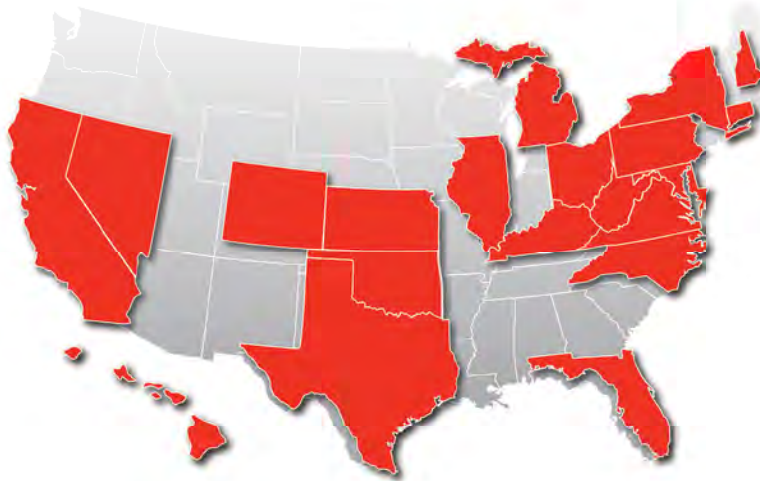
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**For further information, please contact Suzanne LeCroix  
at (256) 265-9639 or [suzanne.lecroix@hhsys.org](mailto:suzanne.lecroix@hhsys.org)**





## SEEKING EMERGENCY DEPARTMENT PHYSICIANS

The busiest ED in North Carolina, and one of the top 15 busiest in the nation, treats 95k adult and 35k pediatric cases annually in its 92 beds. We are currently seeking residency trained BC/BE emergency physicians to work in the 75 bed adult ED. This ED serves a high acuity patient population with 28% annual admission rate. There are over 90 hours of adult physician coverage daily and over 110 hours mid-level coverage daily. It is a Level III Trauma Center with robust hospitalist service, interventional cardiology 24/7, cardiac surgery, neurosurgery, etc. The facility is Chest Pain and Stroke accredited. The EMS system is hospital owned and managed with an award winning paramedic program. Of note, the Pediatric ED is separate and has 17 dedicated beds with an additional 24 hours of physician coverage and 20 hours of mid-level coverage. We welcomed our inaugural class of Emergency Medicine Residents in July 2017. Opportunities exist for both clinical and academic emergency physicians.



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