EPISODE 89 Rocking the Roc! The Reversal of NMBA for Neuro Exam with Sara Hyland

Jimmy: What's good fam, it’s your host, Jimmy Pruitt, AKA PharmD in the ED. And I'm bringing you another episode of the Pharm Soi Hard Podcast. Today, I have another super special episode for you guys today and it's gonna be something unique and special and it's something that my residents will tell you. I've been pimping them on for years now, and I think it's something we really wanna talk about.

In today's episode's gonna be Rocking the Rock. It's gonna be The Reversal of NMBA for Neuro Exam with Sara Hyland and this is gonna be special. And go ahead and introduce yourself for the audience and tell us a little bit more about you.

Sara: Hey Jimmy, it's awesome to be here. Thanks for having me.

Uh, well, I'm a a clinical pharmacist at Grant Medical Center in Columbus, Ohio. Folks may not have heard of us, but what you really gotta know about Grant is we're a busy place and we really know trauma and surgery. We're a big level one trauma center. Uh, roughly 7,000 trauma evals a year. About 5,000 of those are alerts, uh, 60 to 80 K ED visits a year usually, and over 20,000 surgeries a year.

So as a 640 bed community teaching hospital, uh, we, we keep pretty busy. Our motto is, uh, we're not just good wear grant cause it's a high acuity, high complexity, um, often resource constraints type of place, but we really work as a team. Uh, to get done. And at Grant, our pharmacy department is kind of unique in that we have an integrated clinical practice model.

So a clinical pharmacist at Grant doesn't come in day in, day out covering the same service. Uh, we have clinical teams and every pharmacist kind of rotates, um, to maybe three clinical teams. Every pharmacist rotates through the central pharmacy as well. So my current mix is about 75% per op, 25% ED, and I'm kind of like the closer on the ED team, I'd say.

Um, I'm not running the show. I got some tremendous junior colleagues who are doing a great job of that, that I'm happy to support and mentor, but I'm the one on the team who's probably been doing it the longest. I've been there since our inception with pharmacy services in our ED, which was back in about 20 11, 20 12, and I pretty much exclusively worked the evening shift, um, in the ED.

There. One outta every four weeks, um, down there, two to 11:00 PM running around the ED. And I also cover the whole house worth of emergencies, um, response. So when stuff really starts hitting the fan, I'm probably somebody you wanna see showing up. . Um, perfect. How long's not medical practice. Bit more.

Jimmy: Oh, go, go, right.

I was gonna say tell us more about like kind of the, the model a little bit. Cause again, you mentioned something, I don't wanna shy away from the fact that you said part or part ED, Like what does that look like?

Sara: Yeah. So, um, it was a total accident getting involved with the e with the or. Um, I mean, I, I always knew I wanted to work in an ED.

Um, when I was growing up, my parents were an ED nurse and a medic, and I think the EDs in my blood. I just always knew that's where I wanted to be. And so pharmacy was my means to that end. Um, but something else I did during my residency, which was at Grant, um, Excuse me, was, uh, I decided to hang out with anesthesia for a month, do a rotation in the, or just I thought that would be interesting.

And, um, the, or never really let me go after that . And so I basically tried to bring an ED and critical care pharmacy type of mindset and skill set to the perioperative realm. And, you know, fast forward, you know, that was probably 10 years ago. You know, now we have three clinical or pharmacist positions where we didn't have any.

Um, our ED services, um, continue to expand concurrently. We have 24 hour clinical coverage at our ED. We're fortunate, uh, that we've gotten to that point. Uh, we also have a PGY two emergency medicine, um, pharmacy program, uh, that's in its, uh, sixth year. So, um, it's a wild place. I'd say that. The, OR is, uh, it's hard to explain.

Um, I feel like the ED is hard to explain though, when people ask us, like, So what, what do you do in the ED? So what do you do in the or? It's kind of like, you know, I don't know. I'm up there, I'm getting all the antibiotics optimized. And then it's like, all right, the guy getting a TAVR procedure at O six is coding.

We need to get in there and help with the resuscitation, try to salvage the procedure. So with that, we can get the guy back and you know, now he's getting it. I pillow or a balloon pump and then, okay, maybe that level one trauma from downstairs is coming up for an emergent xla and I'm helping with tech guided resuscitation, staying on top of calcium, you know, things like that.

Maybe we got a stat over in 17, they need hypertonics. Um, you know, just everywhere you look, there's, you know, It's not to happen in, I'm getting calls, you know, left, right, and center from, from docs, from nurses, Just all kinds of interesting problems to solve and, and people to help. So it, it honestly that, that's a key message I wanna send to your listeners is, you know, if you don't know what's going on in your, or if you aren't providing the same level of clinical pharmacy services to your, OR as you offer your ED, then it's really time to get up there and farm so hard because it may look different.

We might need to adapt ourselves in our way of thinking and our way of making interventions. But at the end of the day, I would say that my roles as an OR pharmacist and an ER pharmacist and the value that I bring to the team, to those patients, to our providers,

uh, it's really the same. So , if anyone's looking to get started with clinical pharmacy services in the or, uh, acc, CCP has a good opinion paper on this topic and my team's got a lot of resources.

We're happy to share. Overall, our clinical practice model is everybody kind of has, you know, two, maybe three clinical teams. Maybe somebody does, you know, they rotate on critical care ED and trauma. For me it's, you know, or ED, I kind of back up critical care. Um, maybe it's GenEd, trauma oncology, you know, so it's where work hard, play hard kind of group.

And we do that so that we can cover, you know, our clinical services consistently while also protecting our own work life, uh, balances. Because I don't gotta worry about, you know, the OR or the ED getting covered if I gotta take time off. I got bench steps, I got people on my team that are gonna be able to, you know, rotate through and that's how we get it done.

Kind of unique.

Jimmy: That's, that's unique. Cause again, I put a lot of times like places where, you know, in my shops where it's just, you got the ED, you got a few of us in the ED and that's it. Uh, you got people who may do the OR and they have their own group. But I think this is, I think we're getting to a point now where a lot of.

Incorporate some backups and some, some workflows to help out with that. Cause it's getting bad. It's like if I'm not there or my, my teammates can't cover a shift, Like the shift's just not covered or I can't take off. So it's one of those things.

Sara: Or trust me, nobody wants to be that pharmacist that isn't Jimmy Pruitt, like to have a solid

Jimmy: team.

Yeah, it's, it's great here. And I just wanna make sure, go ahead and shout out your, your, your resident. I know that if they're probably listening, that'd be something they want to hear out as well.

Sara: All right. So currently we got Steve Olson, he's holding it down. And our PGY two program this year, he's our six one.

Uh, so style work so far, Steve and, um, it's been a, it's been a wild ride with, you know, developing the services and developing the residency alongside of it. Um, but we're really proud of it. I think we're able to give our residents. This really high acuity, high complexity ER experience, while also offering a host of other, you know, services and perspectives.

Um, like Steve for example, I spent time with the, or he is gotten extra time at our poison center that we have a great relationship with. You can go to, you know, do neurocritical care

at our sister hospital. Um, you can spend time with, you know, our open heart surgery population or you know, just whatever you wanna do.

Between grant and our, our system, Ohio Health, which is 12 hospitals deep now, there's, you know, we can give you all these great elective experiences, um, but we're gonna, we're gonna train you up really well to be very strong, independent, hands on. Um, and the emergency department. First and foremost, we're, we're a very well integrated place.

Like we've had one of the largest run in PGY two pharmacy residency programs in the country. I think we're like the third or fourth longest running one. We've had clinical pharmacists rounding on the floors at grants since 1960s. We're really, Wow. We're really into practicing at the top of our license.

We're very hands on. Um, but we also don't take ourselves too seriously either. We're not an academic medical center. We're a community teaching hospital. And, uh, that's kind of where like the work hard, play hard mentality comes in. You know, we're, we're here also to value you as a person and support you as a person, not just as, uh, a clinician.

Jimmy: Absolutely. That's great. Again, I think it's something that people need to hear out there as we getting ready to start all this. It's very expensive and, and and challenging journey of the, the residency application process. So I just wanna make sure we have that out there so people hear this, they can know what's going on at Grant and making sure they check you guys out.

So let's not, let's transition out a little bit to the topic of this, of discussion today. Can you give us a little background on just the use of neuromuscular blockers for rsi? Just the general overtone and if you of the agent that you see used commonly.

Sara: Yeah, you bet. So rapid sequence intubation is the bread and butter for us in the ED.

Um, it's gonna be the rapid sequential administration of a rapid act sedative paralytic to facilitate endotracheal. Usually in an emergency situation, although you will see RSI done in anesthesia settings, um, it's the gold standard for emergency airway management because it's the way to get to secure an airway in emergency situation as safely and successfully as possible.

And neuromuscular blockers are essential component to rsi, uh, because they're really there to improve intubating conditions in a expeditious manner. Um, Without paralytics our trauma to the airway, our perin intubation complications go through the roof. So the, the clinical outcome that we as pharmacists should recognize that our drugs are targeting is first past success with rsi.

Every subsequent attempts to get that endotracheal tube through the cords results in more adverse events, increased mortality in the, in the perin intubation, um, and postin

intubation period. So maximizing our doses and agent selection of neuromuscular blockers and RSI is a really important role for us.

When it comes to the drugs we use, there's really only two neuromuscular blockers that have the pharmacokinetics necessary to, uh, have utility In rsi, we got SU choline, which is our depolarizing neuromuscular blocker. We got Rium, which is a non depolarizing neuromuscular blocker of the amino steroid, um, class.

And, sorry, I could of lost my train of thought. . There's so much to say about neuromuscular blockers. Cut those part out, Jimmy. All right, so we got Suco, which is our depoing neuromuscular blocker, and we got Rocky Roadium, which is a nonpolar neuromuscular blocker of the, I mean, a steroid class. And, uh, Suson was our historic, you know, kind of workhorse preferred agent.

And, but recently I feel like we've all kind of noticed a shift. Um, and I think we have some data now to back this up, that in the emergency department, you know, the, the adverse event risks and the numerous potential contraindications to suction choline, um, can just kind of create care complexity and increase cognitive load.

And we don't know anything about a patient when they come in through the door crashing. Um, you know, I think our ED providers are kind of getting more comfortable using Roon as a kind of a first line, um, in the emergency department. Not everywhere, but I think that's kind of the, the global practice shift, um, summed up.

And rock run by comparison has a, a much longer duration of action is what we need to, to recognize. And we'll get into some of that, you know, more later based on its, you know, its mechanism. But it's also a lot that I think we think we know about rock in the emergency department that we may need to challenge our understanding about.

Um, so it, you know, if, if we optimize our dose, which really needs to be, you know, 1.2 MIGS per k, um, we can get comparable intubating conditions and success rates with rium as su choline. It does take a little bit longer to work probably, and it takes a lot longer to wear off.

Jimmy: Yeah, that's the big thing. I think people, and I remember I walked around in my ED earlier and I asked a few, a few of my doctors, I said, How long does Rocky Island work? You know, like looked at me, oh, like 30, 45 minutes. Any doses? Like, yeah. I said, Okay. They're like, Wait, wait, wait, wait, wait. , does it last longer?

I said, Oh, you have to wait for that to see a little bit more about that. But we won't give that away just yet. We, we'll wait till we get to a few of the studies and we, we mentioned it before, um, the, kind of the rationale as to why you would give a, a, a, a neuromuscular blocker. Can you talk about why, again, you get to see on both sides why we actually give a reversal agent to a neuromuscular blocker, particularly these, uh, voni and rocky on.

Sara: Sure. So reversing neuromuscular blockade is, is kind of a new concept to us in the ED, I would say. Um, but we have to recognize that this is a routine thing in the surgery realm. So in surgery, there's a lot of good reasons to paralyze patients. Actually, there's a lot of benefits to certain anesthetic plans and a lot of benefits to certain types of surgeries, um, to do it under, you know, moderate to deep paralysis in our muscular blockade.

However, we know that if our patients have residual neuromuscular blockade after we extubate them after surgery, there's a lot of bad things that could happen. There's a lot of adverse events, um, a lot of increased, uh, morbidities, mortalities related to residual neuromuscular blockade after surgery. So generally what happens is, you know, if you have, say you're getting a lap coli, we need to deeply paralyze you during the procedure.

Uh, you know, anesthesia will put you to sleep, we'll paralyze you for the procedure. But the procedure's gonna be done way faster than that paralysis is going to wear off. And so we need to assess the depth of neuromuscular blockade and reverse that to a residual depth that is so light that we can safely extubate you and protect you from postoperative pulmonary complications and other adverse events.

So in surgery, we'll generally, you know, we should be doing this ideally through, uh, quantitative, if not that that's not available. Qualitative neuromuscular, um, blockade, meaning peripheral nerve stimulators, uh, train of four and reversing with either se gamunex or with neostigmine or two available neuromuscular blockade.

Reversal modalities. Whether which one you pick in the surgery realm is based on a lot of different factors, not the least of which is how deeply the neuromuscular blockade is at the time of reversal. But also patient specific factors and kind of your institutional, probably preference and economic consideration, certainly as well when it comes to application of neuromuscular blockade, reversal to the emergency department.

This is something that I think is becoming increasingly explored as well as in the critical carriers. There's a lot of theoretical, uh, situations where I think that we could apply the surgical literature to our critical care emergency department populations. For example, you know, in the, in the unit, oftentimes patients are exposed to neuro SCU blockers repeatedly, potentially a continuous infusion, hopefully not too often, uh, but it happens.

And then eventually we have to excavate these folks, right? So how often are we really assessing the depth of neuromuscular blockade robustly before we extubate patients in the unit, how often could we maybe be. Avoiding adverse events in our critical care populations with neuromuscular blockade reversal, We know it makes a big difference in the postoperative population.

Um, there's even case reports, for example, that two days after shutting off a rocky roadium infusion, people are still completely paralyzed and then we give them smad and all of a sudden they're like, Yeah, please extubate me. I've been sitting here consciously paralyzed for two days . Um, so it's, you know, with everything we're learning about post, you know, intensive care syndrome with ICU acquired weakness, um, all the complications that come

with it, I think neuromuscular blockade reversal, uh, has a lot of merit for further study and critical care.

Absolutely. I think when it comes to, that's one big,

Jimmy: uh, Oh, so that's one big thing. I think we don't think about it. I think we, we, it's one of those things that we've done a set it and forget it mindset. Like, Oh, we, we studied this. This is how long it works. It's like, well, this is how it worked in these volunteers and we had our pharmacokinetic studies, and it may not be as, as as simple as we would think it could be.

And a lot of times now I'm catching me telling my residents like, Well, this is, this is what the textbook says. And they said, Why do you keep saying that? I say, Because I've had patients who've been paralyzed for much longer than a textbook will tell you. And then I've had providers tell me, Oh no, this can't be the case.

I'm like, No. It was like at a channel of four at the drug if the drug patient was pump drug. So it's like this can happen, but it's not the textbook thing to, to look at. So I think that's one thing we have to look at is like, we know that there's many reasons why we probably more so now, we may look at 10, five years and say, we, we, we, uh, reverse everyone now.

So we may be doing it a lot more in the future, but I don't want to. Delay this, this phenomenal paper you, you were wrote. And uh, and I remember I was reading through it and it was like, people don't understand how, like the paper itself is good, but then you have some gems in the back that people don't probably you, you gotta look at as well.

And some of those, those tables and charts back there. But I'll, I'll make sure people go out and look. And of course guys, this will be attached to our show notes in the, in the episode website. But can you go ahead and give us kind of a overview? Again, the title, it's gonna be Sudex to facilitate neurological assessment and severely bring Injured Patients, a retrospective analysis and practical Guidance by primary author.

Sarah right here. You know what I'm saying? I, I, I wish I had a paper that was, this, this is as important with my name is first author, so I wanna jump into it and kinda transition to that. Can you give us some, like a lot of times when we do research, it's not because we are just particularly curious, right?

So a lot of times we have some type of motivation to do so based off of either some things we've seen or some questions we've gotten people, can you give us some background on the motivation to actually conduct research on this topic at your institution?

Sara: Yeah, you bet. So, you know, having this unique mix of periop and ED, my areas of focus for my practice and research tend to be where those areas intersect.

So mm-hmm. , ask me anything about ketamine, you can't shut me up about paint management, let's talk about TX a or factor products for days. Um, and then here we are with neuromuscular blockade and reversal. So, you know, it, it's, it's always been an area of interest for me. And then, you know, what I think started happening was, We have, we had neurosurgical residents at the time that, you know, it kind of caught the ED by surprise when they started asking for this.

So, you know, a patient comes in, you know, maybe Polytrauma, maybe had trauma, and we intubate them with a toing rock. We send 'em to C to CT scan. There's, you know, a big head injury, head bleed, whatever, that we gotta assess. Neurosur comes down and they're like, Well, we need to assess the patient. I want the Gamma X.

And everyone's like, Oh gosh. Like, what's that? Uh, what do I need to know about it? I hear that's expensive. I hear that people die of anaphylaxis or something. Um, there's just, you know, yeah. All this kind of like bits of knowledge that I think, uh, people who don't practice in, in surgery and anesthesia, uh, may have heard about it, but no one's really.

Studied, or, you know, kind of prepared us, given us a framework for how to approach these situations. And it was making a lot of our ED providers uncomfortable. You know, I don't think all the pharmacists, you know, who aren't also, or pharmacists like me, you know, had, you know, a tremendous degree of, of comfort really need the best way to approach these situations.

And I was like, you know what? We just, we just need to look at like an ounce of data here. You know, like, let's, let's just look at what happened to the patients that, you know, we've done this for. And then maybe we can kind of develop a protocol and a, a, a rational approach to something cuz this hasn't been studied robustly in, in our study has not changed that this is, you know, a humble little case series at the end of the day.

Um, but I'm glad it's getting so much engagement because I, I do think this is a topic that, that warrants greater understanding by ED and critical care providers and, and certainly I hope this triggers up further research into this.

Jimmy: Absolutely. So one of the things that as we look at this, we, you gotta give code background here.

Can, you mentioned a few things like it, the case series, but can you give a little bit more, like, a little, little glimpse of like the methodological components of this? Like, you know, your shopping again a little bit. Uh, the primary assessment secondary and like the population included. Cause I think those are, people wanna know, can I use this?

What was done and can I use

Sara: this? Yeah, absolutely. So we decided to keep it relatively focused and just look at one year's worth of patients who received se gamma for the purpose of facilitating a neuro

assessment by our neurosurgical service. Um, excluding anybody who got this as a, you know, a unusual perioperative care excluding any other in.

So, um, retrospective case series, we did pursue a cohort analysis in the sense that we compared patients before and after Sy Gex administration in regards to their GCs and their hemodynamic parameters. Um, but this was not a cohort study in the sense that we didn't have any compared or arm, um, of any kind.

So this is really just looking at all patients who met this criteria and just descriptively, you know, examining what happened to them. What, what impact did SE Amex have on the neurosurgeons treatment? Um, plan was kind of our, our kind of qualitative primary outcome. And then we also, uh, did do some qualitative analyses.

Secondarily, looking at specifically at GCs heart rate and map, uh, changes before and after se Gama administration. Um, we also just did a full case series, you know, in terms of describing these patients, you know, demographic details, their hospital course. And then lastly, I wanted to kind of explore the potential dose response relationship of Saex on these different parameters.

So can I predict how much of the GCs changed or how much of the map changed, um, as a result of, you know, increasing the saex dose? Um, so, uh, that was just a very limited, um, statistical analysis, honestly. Like we, you know, we, we did statistical analyses in the study, but with a, with an N of 12 there, it's, they're not particularly meaningful.

I think the, I think the best interpretation of this study is, you know, descriptive in nature. And so I, we tried to focus the representation of the data, um, with our figures, I think is probably the best way to go. I have the case series. Um, You know, in the first table. But really looking at those box and whiskers plots for how the GCs and the heart rate and the map changed, um, more in a descriptive kind of qualitative manner, I think is probably the best way to, to, uh, evaluate our data.

Perfect. So

Jimmy: that's kinda a good bit of the, the background. And I, and I love it when I'm able to talk to the actual author of this and say, Hey, this is, this is nice. Again, I appreciate the, the, the look of it, but justice realize this is something that's limited. I wish I could do more. This is just one year of this, but it's something that we found that's pretty in intriguing because I think a lot of us probably haven't reversed, you know, Rium 12 times.

Again, I've been fortunate where I've work at Hobb volume shops and I get to, and that's just my thing. I'm like, neuro, listen. If, if you're down here when we're touring them, I'm just gonna go ahead and call and get, get me some Sudan or get me some, you know, sticking based off of that. But I think more people will want to do it because even n of 12 can help people think about, okay, what, what might I see?

And I think as we move forward and look at some of these case series, they can really help us out. But I don't wanna go deep into all, cause I want people to still go read the paper and look at these individual, individual case series. Cause I think it, it, it helps you understand the realistic component of all of this and where these patients actually lead, lead, lead to.

Um, but can you give us some of the major results of, of the study?

Sara: Absolutely. So, you know, as I mentioned, we have, we have an N of 12, meaning 12 administrations. There's actually only 11 patients because one patient actually ended up getting this done at two very different points, uh, in her care interestingly.

Um, but across 12 administrations, uh, We, you know, getting, you know, first into the, the primary, you know, kind of analysis. So what, what did giving Saex do to the neurosurgeons decision making, um, and the plan? So first of all, we kind of separated these out demographically for if this SAEX administration was for making that initial neuro assessment in the emergency department.

So that's situation where I just described, we intubated them. Neuro assert needs to come down and evaluate them for the first time. They're still an ED usually, you know, when this is happening. Um, that was the majority of the patients. Uh, so nine out of the 12, the other three were postoperative assessments.

So these were patients who had already gone through that process. They'd gone to surgery and they were now in the, uh, critical care unit and they were out, They were, you know, had either completed one or maybe more surgeries, um, at this point. And these were postop postoperative assessments by, by the neurosurgical team.

So looking at just the ED administrations, um, the eight, eight of them, um, Sorry, lemme back up. So every, everybody in the analysis when Neurosurg got to the bedside, um, had a GCs of three t uh, prior tos, GAMA X administration. So these, these were people that, you know, appeared completely comatose. Um, when we gave the SE GAMA X, the GCs increased, uh, and ate out of the 12 instances, so the majority of the, uh, the administrations.

And that was kind of an interesting finding in and of itself, uh, because the thes Gatx at this point was administered at a, a median, um, time of a hundred minutes, uh, after the last dose of neuromuscular blocking agent, um, So the range there was 42 to 231 minutes, so that it was that long after, you know, getting the rocuronium.

Um, some of these patients also got vaon, um, mainly the postoperative assessments. So that was kind of like the first key finding is like, wow, we're given this way after, you know, what we think the duration of Rocky Odium is. And yet a majority of patients are having a, a pretty positive response to it.

And so that tells us, you know, we have residual neuromuscular blockade, persisting and interfering with the exam, um, in the majority of patients, even in this timeframe. And we can get into why that might be, but that's, that was kind of the, I think the first key finding.

Jimmy: That's, that's pretty big. Cause I think it does a few things and it's definitely like, like you mentioned before, hypothesized generating, because again, I can't tell people that it, it la Rock ring lasts longer than 45 minutes.

I'm like, a median is gonna last a hundred minutes and we have some outliers there at, uh, 230 minutes. We're talking hours. Multiple hours out. Cause we are thinking, you know, 90 minutes, an hour and a half. So we're talking about beyond an hour and a half, we're talking about close to four hours. And if this happens in this subset, if we can add a zero to the, the, the sample size there, I'm pretty sure we'll be very surprised with what, what we would see in the fact that people can still have a positive response of what I was like pretty intrigued with because I wanted to find something that potentially justified my, my thought pattern when it came to having it down here.

And this is one of the things, at least for me, I'm already doing some of this, so I don't need a huge amount to, to, to help me, um, continue to do like my, my thought patterns when it comes to these type of patients. But it's definitely something I thought was intriguing, especially if you had some people had a.

I would say impressive response, like an impressive neurological response. So that's, that's I

Sara: my attention. Yeah. And some people, this was not just like, okay, they're moving their arm a little bit more. Like, and I, and I was, I was personally involved in a number of these cases. Like these, these were my patients and I was, I was there at the bedside witnessing this.

And, uh, you know, for, for the patients that it, I feel like it's gonna work in, you're gonna know pretty quickly. So we, we push it in less than a minute. You know, the patient goes from completely comatose to immediately animating all four extremities, pulling at their tube. Um, they were clearly very, very awake in there,

And, you know, even though we're a hundred plus minutes out, um, Uh, that, so that, you know, obviously could substantially change a neurosurgeons decision making and Absolutely. And it did , so

Jimmy: yeah, that was, that was intriguing again, just to see that response. Cause I'm thinking to myself, I, I, I know I've been in cases where the patient's like, Right, this, this synchronous with the vent, all these things are happening.

They're moving. It's like, okay. And like this is, you know, soon after. Cause I try to get mine a little quicker after when I know it's gonna happen, but it even makes me more happy the fact that I, you're seeing this so far out. Um, and it's definitely in the back of my head as

well, for even these non think brain damage patients get their brain damaged in having this response

Yeah. Um, what is our medical patients or our agitated patients who we're intubating, who has a decent GCs prior to what some other indications, what are they experiencing? and it definitely made me think quite a bit about, okay, what's my approach and how aggressive should I be, at least initially with my patients that are paralyzed for post sedation with rium?

And I know it's a balance and I know, again, you

can talk about, again, a lot of this data targeting certain, like, so they know, making sure our patients that are paralyzed can receive that same benefit as our suction of choline induced patients as well. So it, it was definitely, it made me think quite a, quite a bit, not just for these patients, but for all patients.

Sara: Yeah. And I think, you know, we obviously have mounting data on how, you know, PTSD inducing it is to, uh, to be a patient in these circumstances. Uh, we have data about, you know, how much longer it often takes for patients who get rium as opposed to alco for intubation to get adequate sedation. Uh, we know that ED pharmacists can really shorten that time.

And I think this really validates that efforts because it's like, you know, we know what, autonomy's only gonna be there for a few minutes, and we don't really know how long the rock roadium is gonna be persisting for. So, so really don't wait with the sedation. Um, but yeah, I mean this, you know, to finish out the, the, the primary kind of analysis there.

So, at the end of the day, between these, you know, CEX administrations, um, every one of them was deemed beneficial to neurosurgeon decision making. Now granted, this was in the estimation of a resident neurosurgeon who was involved with the cases. This wasn't like a blinded assessor, um, by any stretch of the imagination.

However, uh, 50% of all administrations were associated with a change to the neurologic prognosis and the neurosurgery plan. So half of the patients, um, would not have gone to surgery or would not have gotten, you know, invasive ICP monitoring or whatever, Uh, they decided to do. Uh, based on their original exam.

And, and so Gamx changed that plan, uh, with alarming frequency. And so I, yeah, I think this really speaks that, you know, I don't think they're off base to ask about this , I don't think this is a, a bad idea to explore. It. It, it was incredibly impactful. And even in the patients for which the plan did not change, having that increased certainty, uh, you know, my, my colleague who's on the paper, he's, uh, Dr.

Pania, he was, um, think in his fourth fifth year of, uh, neurosurgical residency when he, when he, you know, did this study with us. And, you know, he, he just really spoke to, and

he, he does this in the discussion section, you know, just how vital that is. Like when you're the one that has to go to that family, you know, and, and deliver this devastating prognosis.

And that there's, there's really nothing that, you know, we can do. You wanna know with certainty, you know, that that's, that's the accurate assessment. And, you know, reversing neuromuscular blockade is, is just one part of that, obviously. But I think with ci GAD X, this, this is a, could be a very important tool, um, even if it doesn't change the plan.

Jimmy: Yeah. And one of the things I want the, the look at as well, it's something that I think may shock people who are not necessarily used to using Segas or Neos sicking. Um, it's kind of the, the hemodynamics. You mentioned quite a bit of this in, in, in the paper. Um, we didn't get the exact response that I, I thought was gonna happen, but there, as far as like which henas changed, but can you kind talk about a little bit more about what you guys found with your data?

Sara: Yeah. So that, you know, that that was kind of, you know, the first question is, you know, what's this worth? What's the utility? But the second question, you know, that I wanted to try to, you know, assess with this paper is how safe is it? What, what do we need to be worried about with it? And, you know, we, we had a pretty, you know, profound GCs response among some patients and a GCs response of some amount, and the majority of patients.

Um, but what, what was the risk? And specifically with sudex, I think, you know, we, we just try to hone in on, you know, the biggest risks that we're worried about. So, you know, all of these patients are either, you know, TBIs or, uh, spontaneous, uh, ich. And so, you know, we, we know thats gamx can cause dose and rate related hypotension, bradycardia, also biotech, tachycardia, and rarely there have been case reports of just complete cardiopulmonary arrest, um, a cardiovascular collapse, rather, uh, with se gamx and, uh, They've been rare, but they have been probably more prevalent in patients who are critically ill and in patients who, you know, would be predisposed to hemodynamic instability.

So we have a worst case scenario to watch out for. And then we also have just, you know, what's the garden variety TBI patient going to see in terms of hemodynamic response? Because we know that, you know, maintaining blood pressure is important to maintaining cerebral profusion pressure during times of, you know, acute brain swelling.

It's, you know, this isn't a population where I really wanna tank their pressure, um, precipitously. So, you know, that's, that's why we really honed in on, on heart rate and on map. So looking at that, so, um, the vast majority of patients. Uh, nine out of, you know, these administrations, uh, 82%. Um, their map went down somewhat to some degree, and, uh, 55% of all patients, their heart rate decreased to some degree, um, newer worsening bradycardia or hypotension.

Um, which we defined as, you know, a heart rate less than 60 or a map less than 65 that occurred. One of those, one or more of those occurred in 27% of administrations. And we

did have several patients, um, who, you know, they started probably above their age specific MAP goals, um, you know, for the, for the particular, you know, disease state of tbi, and then ended up below them after EDex administration.

So it, it happens, um mm-hmm . So we, we, we assessed, you know, to, to what degree. And so when we, you know, kind of pursued this in a, in a quantitative manner, Um, the median change in map was, uh, a decrease of eight millimeters of mercury, um, with a 95% conference interval of going down by 25, or maybe even up by three , so, mm-hmm.

Um, and there was, again, a very wide range there. Like I had one patient whose map went down by like 43 . So there's, um, there is a potential there. Now, these assessments were not controlled and they were not standardized. So, you know, that's, that's a huge limitation is these were not, I basically just looked at the first set of hemodynamic parameters before SE Gamunex was given, and the first set available in the chart afters was given.

As long as those occurred within two hours of administration. If there was nothing in the chart until more than two hours after se gamx, I excluded them from, from the quantitative analysis. So, you know, I, I, I, this should not be interpreted as, you know, if I were to give everybody CI Gamma X and then exactly, you know, one minute later, five minutes later, 10 minutes later, you know, do these assessments, you know that that's the study that needs to be done still.

Um, but just looking at what was available in the chart, just looking at right before or right after, um, you know, it was clear that, you know, there, there is a hemodynamic effect, uh, that that is risked with this tool and that needs to be considered. Now, nobody to the extent that we were able to determine on retrospective chart review had like a significant event, meaning like nobody arrested, we weren't coding any of these patients.

Um, I didn't see any of those kind of catastrophic worst case scenarios evidenced in the chart anywhere. Um, but did see a significant reduction, um, in map. Uh, the reductions in heart rate were more nominal, probably not clinically nor statistically significant. Um, just kind of slightly lower. And then I kind of try, wanted to stratify, you know, between the patients who responded to SE Gamx versus the patients that didn't respond to SE gamunex.

So I kind of analyzed all comers, and then I kind of divided into those subgroups. So the patients who had a positive GS response versus the patients who just remained at three T even after se gamunex. And, and if the hemodynamic changes were different. So, you know, do we have to be more concerned maybe in patients who still have a salvageable, um, brain to some extent versus those, those who don't, Is kind of like the, the theoretical question there.

Mm-hmm. and. So that's kind of what, uh, figure three is about.

Jimmy: Perfect. And that's the, that's the big point I think everyone wants to need to look at because when I, when I hear that, it makes me not always necessarily pretreat. Cause I don't

think, I don't know if we need to pretre what, what aro with Yemen X I'm not, I'm not as jaded.

I think I'm more jaded in affected, I don't think is perfect when it comes to that. So I have things around me. Um, but I started thinking about things like push those. . And depending on what time this happened, I may not pretreat, but I may end up having something like that around me, um, just in case cuz, But I literally carry Christo's happy with me in my pocket at all times.

So it's something that, um, I do a little bit more, but it's something that I may consider a lot more or what I'm teaching residents and students that may be something that I'm like, Hey, this is something that I'm doing. This is the data saying why I should look at it. Now, I'm not saying that this is end all, be all, but it's something that at least I don't, I just don't like surprises.

That's my thing. I don't want any surprise. And if that's the case, I wanna make sure that I, I at least have something around me to kind help me from that standpoint. So, at least from a, a safety standpoint. That's what I wanna look at. And again, this is, it is, its a lot. And I think, um, you mentioned quite a bit of it before about the limitations, so I won't necessarily go deep into, into that.

You, you kinda kinda mentioned that throughout. But what I do want to get is kind of your overall big takeaways that people should, should take from this and, and how would you like people to utilize this information?

Sara: Sure. So I, I think, you know, just going on like what you were just talking about, like, I think that when it comes to the safety side, uh, we need to be prepared for this.

We need to be prepared for, uh, probably a few different things. Um, and so I think it pays to, you know, thoroughly assess that prior to, uh, considering this, Like for example, I remember once, you know, I got called up to the unit and Neurosur wanted to give it postoperatively to a patient who just wasn't waking up quite the way they wanted to after, uh, an intracranial procedure.

I look at the patient and she's, she's very advanced age. She still has dex amount vomiting, running at like 0.8, and her heart rate is like 55. And I'm like, Okay, so let's back up a minute here. So I think what, what we really tried to do was, you know, generate a framework and, uh, some advice for, you know, how, how to approach these situations.

And we, we kind of systematically laid that out, um, in table three. So first question being, you know, what is this, you know, gonna benefit the patient? And second global question being, you know, what are the risks to this particular patient? And then how can we make this most safe and successful? Um, so when it comes to the safety side, to your point, you know, I, I absolutely recommend, you know, optimizing hemodynamic status first, to the extent that it's appropriate for your patient, but also being ready.

For, you know, I, I totally have a push to step be with me. I have attri with me. I have, you know, I have my whole box there ready in case you know what, whatever happens. Um, but if they have a very tenuous hemodynamic status to begin with, I do think the risk benefit changes. Um, especially, you know, if, if it's a TBI patient and it's, you know, it's, it's different.

It's very different, a very different risk benefit than, than how we're using it in surgery. So I think key takeaways, um, first of all, Rium lasts a longer than you think it does. , just because they were intubated in the field with Rium and that was an hour ago, doesn't mean it's long gone and not interfering with your present exam.

Um, just because it's an hour plus, you know, after, by the time Neurosur comes down, they've already been through ct. Um, it's not gone. And, uh, we can get into why that is if we really wanna go down the rabbit hole. But, um, that's kind of the first. Key takeaway is the duration of neuromuscular blockade is, is substantially longer than you give it credit for.

And uh, there, there was evidence in our, you know, small limited data set, but very clear evidence that it was, you know, beneficial to the decision making for these patients. It, it changed the, the course, um, for these patients. Now, unfortunately, you know, this was a very high risk group. These were catastrophic, um, you know, head injured patients and, you know, the, the majority of them expired.

Um, but there was, you know, evidence there that, you know, there, there is a benefit to the strategy that should be explored further and considered.

Jimmy: Absolutely. I just think like, and then I don't wanna cut you off. You can continue any, any other take away.

Sara: No, there's a lot to unpack there. So Yeah, yeah, go

Jimmy: ahead.

It, I, I just think about it. It's like, again, we have to kind of take everything as a whole. We look at these papers and say, Okay, it can be beneficial. Definitely. Um, it's something that our team really thinks can be beneficial. And I think, I think what it does for me is provide a certain level of certainty and on one end of the spectrum.

And for me, as from a safety standpoint, it provides me a little, a level of uncertainty as far as, and, oh, this is fine. The paper said doesn't cause any many, it doesn't cause much of a hemodynamic, uh, issue. So it gives me certainty for my, my neurosurgery colleagues providing their, their diagnosis and their prognosis.

And it provides uncertainty for me when it comes to just kind of relaxing, put look my guard down and not communicate with the team, Hey, this is what I'm. This is what I can expect to

happen from a neurological standpoint, but this is what I can also expect to happen from a, a hemodynamic standpoint.

Those are the big, big things to get away from this. And also I thought, I wanted to see if he, he had a idea of, you know, the big thing that comes around with the cost is the, the dosing is a lot of dosing recommendations out there. I wanna see your input on that.

Sara: Yeah, so we, we spent a lot of time on this.

So this, this paper was a very collaborative effort. Um, you know, it had pharmacy, it had neurosurgery and it had anesthesiologists. Um, on this paper. All really, they kind of put in our diverse perspectives and heads together, really reviewing the literature and trying to figure out the best way to approach these situations.

So when it comes to the dose, you know, and we have an exhaustive, you know, really boring discussion on, in defense of this. But the moral of a story is you, you really don't need to give a lot of sgamma ex in these situations. In our assessment, when you think about the unique risk benefit for this population, you're unlikely to gain additional benefit above a dose of probably 200.

And, um, you are probably risking more adverse events. And when you break that down, you know, there's the, the manufacturer recommendations, you know, their recommendations are for reversing moderate or deep neuromuscular blockade. And at this point you're probably, maybe, but you're probably not working with that deep of neuromuscular blockade.

You're probably working with more shallower levels and shallower levels of neuromuscular blockade have been shown to be reversed with su gamma X at much lower than, than labeled doses. Um, there are current guidelines where you can, you know, look. And studies, you know, using doses as low as 0.5, kinda in the 0.5 to two milligram per kilo range.

Um, so first of all, you, you probably don't really need to give more. The reason we give more in the perioperative realm is cuz we're extubating the patients and we don't want them to have residual neuromuscular blockade that's going to put them at, at risk for postoperative pulmonary complications and things like this.

Um, I can't give those benefits to a, to a horrendously brain injured patient who's gonna, you know, remain intubated. So there's, there's no need to go to go too high with the dose, um, in, even though, you know, there is controversy I will say in terms of which weight scaler we should use for the dosing. Um, whether, you know, we should be dosing gamx based on total body weights for our obese patients, or more of an ideal or an adjustment of some kind.

I think that the, the evidence does support that giving, you know, rounding down, at least , I think the best evidence is probably with a 40% adjustment if you're really getting into the

weeds. Um, but more of a story is you, you don't really probably need to be shooting for a total body weight, you know, two plus milligram per kilo dose, um, in this population.

And if you, um, if you look at the first patient or case series, she's kind of like the quintessential example of this. You know, she's a morbidly obese woman and, you know, we gave her, you know, comparatively a very small doses of Gamit X and you know, she was one of the ones that went from, you know, totally comatose three T to jumping off the bed just about.

Um, so, you know, this is anecdotal, but you know, we integrated a comprehensive review of, of the literature from, from all, you know, sectors of healthcare. And, um, I think that, that, that lower dose is justified from a beneficial perspective. And I think that's also a way to just help limit. Adverse events. Um, and then it's also about logistics and to some extent about economic considerations.

So it comes in 200 or 500 milligram vials. Um, so a 200 milligram vial is, you know, it's ready to use. That's something that, you know, I carry around in my box. It's something that potentially, depending on your institutional, you know, comfort level and protocols that you decide on that you could stock in an automated dispensing cabinet.

Um, it's a, it's a ready to use IV push medicine. Like you, you can get se Gama X in a patient as fast as you can get. How all you know in a patient, there's, there's not really preparation involved as long as, you know you're prepared for it at your institution and you, you have it somewhere, um, you know, not too far away.

and. It's undiluted, you can give it, you know, the manufacturer says to give it over 10 seconds and an anesthesia, I can tell you they just, you know, scored it right in there, . It's, and it's how the ER nurses are used to giving out over, you know, basically. So, um, I do think that giving it more slowly, I generally have them push it over kind of like a 30 to 60 seconds, you know, And in these types of settings, because these are not, you know, garden variety optimized, perioperative patients.

They're, you know, generally very critically ill at this point. And, um, so I do recommend, you know, it's probably prudent to give it a little bit slower, but you, you don't really have to give it super slow. You don't have to prepare it, you know, really in any way. So using a 200 milligram dose, I think it's justified from an efficacy standpoint, from a safety standpoint, from a logistics standpoint.

From a cost perspective, each one of those is probably gonna cost you about $150. So it's not nothing, but it's also not like, you know, K Centra, it's not nobo seven by any stretch of the imagination. You know, if you're pulling out a couple, uh, pre-made TXA bags, uh, putting, you know, putting on everything like hot sauce, as we like to say, you're, you're probably not, not too far off from a, from a 200 milligram dose to Gex.

You know,

Jimmy: And that's the big thing is like letting people know is like, is is this where, you know, we just have a few of 'em in the ED, Have a few of 'em in the, in Omnicell or whatever your expense cabinet is and use from there, because that's the conversation that, you know, I'm thinking about moving in a certain direction.

Cause again, that when I want it, I want it right now. And I don't necessarily always want to cough upstairs, but I find okay with that process. But I think knowing that we're hun we're talking 150 bucks here versus, you know, And then the times that we're using this again, potentially 15 times in a year, you know, it's like, uh, you know, it's not something that I'm gonna stress out too, too much over.

Cause we're not, we're talking a couple thousand over a year versus what people probably think that's gonna be. So that's one thing. But I wanna transition to my, my my last question for you before we have any closing remarks. Now, now that you've done this study, if you were to design any study you want with any amount of money that you want, um, what, what would you, how would you design it and what would you wanna look at?

Well,

Sara: I, I appreciate that question because I've started on the path of, uh, assembling a research work group. I've sent out some calls, you know, through the listerv, through, you know, on Twitter, you know, for people who wanna collaborate on this. But I, I think there's really several worthy studies, um, that I have, you know, on my radar that I think we could pursue as, you know, a research work group or that, you know, I certainly hope all kinds of other people, you know, do as well.

I, I think. First of all, just kind of getting like some baseline survey data, quantifying this practice, um, you know, in different parts of the world. This is, you know, It's worth, I think, reminding sometimes our, our ED colleagues that SE Gamx is a drug that's used around the world probably hundreds of thousands of times every day.

It's something that has been in clinical practice since 2008. You know, we didn't get it in the states, you know, here until, you know, probably about 2016. Um, but it, we, we have over a decade of clinical use and it is used a lot around the world. And so just, just kind of getting some survey data on, you know, how is everybody applying this to non-operative settings?

How are you, you know, considering this in the emergency department in critical care, um, who's ordering it? What doses are you giving? You know, just trying to get like a, a pulse check on, you know, what the current state is, I think could be helpful in guiding for other research protocols. So I'm hoping to do something like that.

But when it comes to like really generating the data that is needed to definitively answer these questions, you know, I think we need to do, have a prospective standardized protocol. Blinded assessors, standardized. Times post administration for the assessments. We need to standardize, you know, our doses of the rocuronium.

We need to standardize, you know, our doses of the saex and how, you know, frequently we're assessing it. Um, I don't know that it would really be feasible or ethical to do like something totally placebo controlled unless you're, you know, obviously always going to let them get to Gamunex if they got placebo.

You know, maybe. So there's, you know, some nuances there that I think would have to be worked through. But I definitely think that, you know, doing that in, in a prospective controlled manner, you know, across diverse institutions is, is what's needed to really quantify the benefits and the risks and to validate this, this dosing strategy.

Jimmy: Absolutely. I think that's something we just have to, we have to hear out sometimes. Cause some people just may not know. Like, I would like to do something like this. I have to, I have the time to do it, but I don't know what I would do, you know, if, if, if I had done some research before, I have a better understanding.

So I think this is a step where people can say, Okay, well I don't have all information but I have an expert that's if let's done something on this, this, this, this, they would do. So I think that kind of helps us and hopefully if someone can hear it is and. Oh, well, well, let me, let me contact Sarah to let them know like, Hey, I'm actually on board with this now, so let's, let's get this done.

Um, but we, we've, we've unpacked a lot of the information. Um, we, we've looked at kind of some of the things that you've done at your shop, really let the world know what an OR ED pharmacist does. Then we've kind of went forward to kind of giving some background on the newer Mexico blockers and why we even use them in, in RSI and why we want to reverse them.

And we look at this great paper that, that you've done and, and had some kind of, some key points on the great, great points of this that surprises, uh, as far as, you know, the, the, the impact that we can see with reversal and that the duration of action of neuromuscular blockers. And then lastly, talk about some different, um, some dosing on cons, considerations.

And maybe we should. Find some kind of way to design something else. That's really our, our big point for today. Is there any closing remarks you want to get even about this study, about anything you're doing or just, just just close remarks in general that we have for the audience today?

Sara: Sure. So I guess to close out, you know, the other clinical considerations to just, you know, get on people's radar that may not be widely known.

You know, if, if you're starting to do this in your ED or you're thinking about it, um, you know, it's really something that, given SE Gamx has a lot of potential downstream effects on the complexity of the patient's subsequent care. So if we're gonna reverse, um, them with

se gams in the ED and Neurosurg decides to take him to surgery, they're not gonna be able to immediately repa the patient with rocuronium or bium in the or.

And, you know, for a cranny, we generally want them deeply paralyzed. D depending on, you know, which procedure you're doing. So, They need to understand that, you know, okay, you're either gonna have to use a lot more rocuronium or eronium in the or you're gonna have to collaborate with anesthesia, um, to maybe use a different class of neuromuscular blockers.

You know, if you're gonna give 'em atracurium or cis that, you know, subsequently those are gonna work just fine. But keep in mind, you can't reverse those withs, gamx mm-hmm. . So, um, it, it can kind of be a lot to think through. And so I, I think it really needs to be a timeout. And that's kind of, you know, why that's one of the questions and I recommend an assessment is, you know, what other care complexities do we need to work through and who needs to be at the table to work through those?

And I, I really think ideally that should be, you know, in a situation, the, the, the neurosurgeon. Also with pharmacy, with anesthesia, potentially with the ED, you know, or critical care, you know, who, who are all are gonna be all these people downstream that, you know, have to consider these. Um, another thing that's gonna come up is se gamunex interferes with some of our coagulation assays.

And so in our trauma patients and our ICH patients, you know, if you see your in andr, your A P T T, uh, looking prolonged, that's could be artifact from the se gamma damages doesn't actually increase, uh, bleeding. It is an inter interference with the assays. Um, and there is at least one study that I know of looking at TE parameters where they found that the R time was very slightly increased, um, with SE Gamma X, but stayed within normal limits.

So don't let people freak out or start asking for, uh, anticoagulation reversal if, you know, you are misinterpret that, I guess, you know, if that's not really what's going on. Um, cuz the gatx can, can't interfere with those. So, you know, there's just, you know, all these kind of strange scenarios and potential complexities can come up down the road.

Um, you know, another risk is if you push it, you know, if the, is the patient gonna self extubate, ? Are you, are you ready to, to resate the patient in addition to, you know, responding to any hemodynamic, you know, adverse consequences like we discussed. So, um, really talking people through that and being prepared for all those scenarios and providing that continuity of care and that kind of team based based approach, um, I think is really important.

Or there's a lot that can go wrong, I think, uh, downstream after this. So, um, but definitely I recommend, you know, checking out table three for kind of like our recommended kind of comprehensive framework for, for the approach. And, you know, the paper has, has a lot of discussion there. If, if you really wanna kind of get into the, the rationale of why we, why we proposed these things.

When it comes to other stuff I'm working on, I mean, I keep pretty busy. There's no end to the research questions that abound, I feel like in our environment. So some things I'm working on right now. Uh, the pharmacist role in stemi, uh, I think is something that I'm really excited, hopefully to be getting submitted here soon.

Uh, pharmacist role in perioperative emergencies. Um, it's something else that I'm working with a great group on in that realm. Um, hoping to kind of just bring some nice, uh, kind of how-to guides and like reviews, you know, to the world to kind of help folks familiarize themselves with these roles and, and how, you know, maybe our roles maybe look a little different, but how they're no less important and what they, you know, what they should look like, um, across these different areas.

Um, also doing stuff with, uh, ketamine, with paid management, with, you know, all my favorite stuff. So, Next time, uh, I'll call you up and you're gonna publish with us, Jimmy. Hey,

Jimmy: that, that's how I'm looking for kind of getting, getting down with that. But Sarah, just thank you for coming on. I think we, we talked earlier, I was just super excited to get you on and the time and the topic kind of just really meshed at, at this time.

So it's gonna be coming out pretty soon for people, most likely in the month of, of November. So, um, I just thank everyone for listening again. We, we've had a ton of information here. The paper definitely is gonna be in the, in in the show notes and all the other work that we see, uh, Twitter handles and all that good stuff's gonna be out there so you can reach out with us.

But again, I like that. Remind you guys that the other work that we have going on, of course, if you like the work that we do here, the information we doing, you can definitely check us out on the path. You, again, that's pharmacy at Acute Care University, we. Entire culture change that's coming in a new year that I would keep you guys, uh, looking forward to you around this time.

We'll be recruiting for the challenge. It's gonna be one of the first clinical skills competition virtually for pharmacists. And it doesn't matter if you're a student, a resident, a actively practicing person. We're gonna be doing something to where we can help, we can help build this kind of, this new curiosity for answering questions again.

And it's gonna get you, get you guys prepared for this top discussion, work prep, things that nature. That's what we're gonna be getting ready to do with this new thing called Call, call the challenge. So, uh, look out for that and look up for more episodes. We we're, we've been powering out. This is, uh, year three for us, so we're super excited for all we've been doing and all the support we've been having.

So, um, lots of more stuff coming soon over the, over the next few. Again, you guys are gonna see a ton of stuff happening out over next year, so, uh, super excited for that. Sarah, thanks for coming on. Um, and just wanna, we can close this out if you want.

Sara: Thanks Jimmy. Appreciate it. Awesome to be with you tonight.

Jimmy: All right, thank you guys. And you know how close every episode, you don't have to be a pharmacist, you don't have to work in the ED. But everything you do, make sure you Pharm So Hard.