0:04
Hello, everyone.

0:06
Thank you so much for joining today's session entitled Biomedical Research 101.

0:12
In today's webinar we're going to learn the basics of biomedical research terminology to understand the basics of the clinical research process and how to find out about current peripheral neuropathy research.

0:24
My name is Lindsey Colbert. I will be moderating today's session. I am the Executive Director of the Foundation for Peripheral Neuropathy.

0:32
And again, I thank you all for joining the session today.

0:37
Before we get started, though, I just want to cover a couple of logistical items.

0:42
The presentation today is being recorded.

0:45
We will not only e-mail you the link to the recording, but we will also upload it to our Website, along with the slides and PDF, so that you can have all of the materials are seen at your disposal following this webinar.

1:01
During the webinar, we ask that you submit your questions through the questions box in the dashboard.

1:07
We will try our best to answer as many as we can at the end during our Q&A session.

1:14
And if at any time you are having trouble with your audio, I encourage you to go back to the e-mail registration and check in with the phone number.

1:26
That might also be another option if you're having problems hearing me or hearing our guest speaker today on your computer.

1:37
And at this time, I'm pleased to introduce our guest speaker for today, Christy Thousands.

1:43
Christy holds a PHD in neuroscience. She's been investigating the brain and nervous system and the regulation of energy balance and metabolism for the past 20 years.

1:53
She is an associate professor in the Department of Neurological Surgery at the Ohio States, Wexler Medical Center, and she is also integral and the term for his lab for neurobiology and

energy balance at the Ohio State University whose research focuses on neuroplasticity and how the brain and nervous system impact appetite, metabolism, and energy expenditure.

2:17
Christy is also the Foundation for peripheral neuropathy's newest board member having joined in June of this year 20 21.

2:25
I'm so delighted that she's a part of our organization's team and I'm overjoyed that she has offered to share her insights on peripheral neuropathy research in today's educational session.

2:35
So, Christine, thank you again, and I'll turn the microphone over to you.

2:40
All right, thank you, Lindsay.

2:43
So, I'll just wait until let's see, I should be able to gain control the slides here. There we go. Alright, well, I'm happy to be here today, and I'm excited to really make this a discussion with all of you. So, please make sure you put any questions or comments into the chat box. And I look forward to chatting with you about those at the end of the session today. So yes, I'm going to give a very basic introduction to biomedical research, to how it's done. Some of the key concepts, some of the checks and balances, and also give you some examples. And when we talk about biomedical research, there's this catchphrase we hear all the time called from bench to bedside, so you'll learn what that means today, as well.

3:25
So here's what I'm going to cover, First of all, just a little basic overview of the scientific process, and how that relates to biomedical research going from basic to clinical.

3:37
We're going to talk about the gold standard of research, which is publications in peer reviewed journals, funding for research, and how that works, and is managed.

3:47
Some of the safeguards, so research, rigor and research ethics.

3:52
And then information for all of you in the public and patients as well, how you can find current research studies, especially regarding peripheral neuropathy and how you can vet research news to know what's a reliable source of scientific information information. Excuse me. And then finally, we're going to end with some specific examples of current research happening in the neuropathy space. Basic, all the way to clinical, and I'll tell you briefly, as well, some of the research we work on in my lab.

4:22
Alright, so we're gonna begin today with an audience poll. We're going to have three audience polls throughout the webinar to hopefully get everyone more engaged. And this is always difficult through these teleconference webinars to feel like we're together, but this hopefully will help. So I'm gonna throw it to Tonya to start with the first audience poll.

4:41

So this one is, how comfortable do you feel with understanding the processes involved in conducting biomedical research?

4:49
So, go ahead and just select what you feel is your comfort level currently right now. And hopefully, by the end, we see that this has gone up for all of you.

4:58
So, I'll just give you a few seconds to select your answer.

5:02
You all should see a box in front of you that you can click on to choose either A, B, C, or D, and when we're done here in a few seconds, we'll see the results.

5:16
And tani, I think we're good there. Great.

5:20
Alright. Interesting. So, we have about 18% of you who feel very comfortable, 31%, at both somewhat and a little bit, and 20%, not at all comfortable, So quick math here. I guess we have 82% not feeling very comfortable, so that's great. Tani, We can go back to the slides.

5:37
That means hopefully today I can impart a little bit of knowledge and understanding to all of you OK, So let's begin with, let me click here, the scientific method, so, of course, we've all heard of the scientific method, learned about it in school. But what's interesting is this has really been time tested as a successful approach to undergo scientific investigation.

6:00
So, this is a cycle. It's circular and it repeats itself, no matter what you're researching. And anything you do ends up opening up more questions.

6:08
So, you start with asking a new research question that leads you to formulate a hypothesis, which is essentially a guess. It's an educated guess. Based on what's already been published in a research field and based on data, you may have collected yourself and your own laboratory and you're sort of synthesizing that together to make an educated guess or a hypothesis.

6:30
Then you actually design, conduct, and analyze an experiment. And I think those three parts of it are actually each equally important. So the design of an experiment is really going to impact the type of data you get and how well you can interpret that data.

6:45
Of course, conducting an experiment is hugely important.

6:49
There's lots of detail, and protocols, and procedures and techniques go into that. And then once you collect your data, you need to analyze it. So there's a lot of statistics and different methods used to take a look at your data and see if it is giving you a clear answer or not.

7:08
From there, you've got more information. So you observe you, think about it.

7:12
You synthesize again, pulling in from other research, studies that you did or others did in the field, and then you're going to sort of adjust your conceptual model. How do you think the systems working?

7:24
And then, of course, the cycle repeats itself. You ask a new question after that. And, most importantly, you report those research findings, both to your community, but also to the greater public who, in a lot of cases, are funding the research.

7:41
So, this scientific medicine has been pretty consistent over time.

7:44
And it's very reliable, But it's also something that's constantly improving. So, this is just a little bit of a timeline of how the scientific process has changed throughout history. But I think if we zoom in, we can see some key steps that happened at different points. So here, in 15 92, we have Francis Bacon, he showed that a controlled experiment is essential. So this is changing just one variable at a time, so you know how that one variable impacts your system.

8:16
Next in 16 65 we have Boyle Teat teaching us that we need to repeat experiments.

8:22
So, things can't be repeated reliably. There probably weren't a real answer. That's all. We can get data sometimes that looks convincing, but it's not if it can't be reproduced.

8:33
Peer reviewed journal publications came in here quite a while ago, and it's in run 752, so, we'll talk more about that process, and how it looks today in 20 21.

8:44
And you see some key concepts coming in here related to testing, drugs, and therapies in humans.

8:49
So, blinded randomized designs, placebo controlled trials, double blind experiments. So these are all critical when we get into talking about clinical research.

9:00
And then we'll talk a little bit today about this last one here, which is a meta analysis. So this is taking a huge group of studies that came before and analyzing them all together to see if they come out with a consistent finding.

9:15
This is a recent graphic coming out of the National Institutes of Health, or the NIH. They're calling it Follow the Science. I think it's coming out right now. Because in some cases there's been a little bit of distrust or misunderstanding of the scientific process, but I really love this graphic and I thought it was good to go through today. So starting at the top here, if we look at the process of how science is done and especially biomedical research research.

9:41

The key thing at the very beginning is bringing diverse techniques and diverse skill sets together. And we'll talk more about that as well.

9:48
That science really has become more and more a team sport and people are not just a single scientist toiling away in a laboratory by themselves late into the night. They're actually working and collaborating with diverse teams.

10:02
Accumulating evidence is the next part, So collecting data from your experiments, evaluating what they mean, and this can lead to new ideas like we covered in the previous slide.

10:13
Sharing data is the next critical step. So we don't know how to build on the work of others unless we know about it. So sharing our data with our community, and, as I said before, also with public, are really important aspects of this cycle of doing science.

10:29
And then the important thing to keep in mind is every one of us contributing a single research study, it feels like this huge task that we've accomplished. And a lot of cases it is, but really, we're just a small part of a bigger picture. So our job, as scientists, is a lot of the time to read what else is out there, and figure out how our work fits in in the bigger picture.

10:51
And then, over time, and this sometimes is decades, this sometimes is just a few years, depending how rapidly a field of research is moving, But over time, you build up enough cumulative evidence to be able to draw some actual conclusions. So things like the cell theory, the germ theory that we now know are scientific facts and truths.

11:11
That that took many, many years of experimentation, replication, and accumulating evidence to be able to show that those were foundational, tenants, and biology. And then, of course, we end with the most exciting part for all of us, which is more questions. So we never have to worry about putting ourselves out of business. The human body is wildly complex. And there's always more that we can uncover, especially as new research tools become available.

11:38
OK, so now let's drill down and not just talk about science in general, but more about this transition of biomedical research from bench to bedside. What does that all mean?

11:48
The foundation underlying all of this is what we call basic research. So this is the knowledge that will someday inform prevention treatments, therapies, or it's the knowledge that provides just a better understanding of disease mechanisms and human health.

12:04
From their basic research, is used data found as a foundation to move into translational research. So this re type of research aims to move these basic findings from model systems into humans. So this is bench to bedside.

12:19
Also called proof of concept and sometimes called pre-clinical research.

12:24
From there, we move into clinical research. Now, we're in the humans. So this is applying what we've learned in basic and translational research to human patients or utilizing human samples. This is also where you start to see the phase clinical trials that I'll talk more about in a minute.

12:41
And finally, research beyond that, is when you start to build up all the accumulating evidence, This is where meta analyzes come in. This is where population and community level research comes in, et cetera.

12:55
So going through some more examples of each of these, when we're talking about basic research, especially around biomedical or peripheral neuropathy, we're really drawing on a bunch of different disciplines. So Biology, of course, which is the science of life, that underlies all of this, and Biology is nothing without physics and Chemistry, so we all do have physics and chemistry in our laboratory day-to-day routines.

13:19
Physiology. So that's how the body works.

13:23
Whether we're talking about a mammal, that's not a human or a human cell and molecular biology. So this is getting more drilled into the microscopic level, looking at how cells function.

13:35
How they function together in tissues and organs, and also the molecules within a cell that allow the cell to do its job. So that's things like DNA and proteins that carry out the functions of a cell.

13:47
Biochemistry is the chemistry of life, And then, of course, pulling a lot of these together is biomedical research, and these are just a couple examples, but there's many, many more disciplines within the basic research column here.

14:01
As we move into translational research, a lot of people are using model systems. So, these are other living systems, either organisms or cells and tissues that mimic and represent how a human body would function.

14:14
So, we can have in vitro studies that's Latin four in glass, although we use plastic, We're now in 20 21.

14:21
But this is growing cells and tissues outside of a living organism to be able to figure out how the cells function or respond to treatments and things like that.

14:32
In vivo, this is Latin for in life. So these are the Organismic Model systems used, again, in a translational way, so they have a lot of genetic similarity similarity, and functional similarity to humans. So, the findings from these animal models are relevant.

14:48

We use even a single celled organism. A lot of key findings about cell biology came out of studying the single celled yeast.

14:57
The same nice that we have in Beer, and Brad, and all of that.

15:00
The fruit fly next time you swap them away from your bananas that are going bad.

15:05
Just think about how these organisms they're called Drosophila Land Jetstar. These are key genetic organism for studying a lot of different systems including the nervous system.

15:15
Zebrafish worms. There's a worm called C elegans. That's a commons model. And then, of course, mice.

15:24
And there's other, many, many other animal models, as well.

15:27
Then in silica, this is more of a recent phenomenon, a recent development in biomedical research, using computers, and mathematics, and things like that, to study biological systems and to model them.

15:40
And then, for clinical research, this is really vast. I'm just giving you a few examples here. It could vary from a single case study where a patient has a rare condition or a rare phenomenon within a disease state and it's reported out to the medical community.

15:55
It could be biomarker discovery. So figuring out how to test for different disease states and screen for them.

16:02
Investigating treatments and therapies and other interventions and testing their efficacy in humans, Developing diagnostic criteria. Investigating more about disease processes in humans, on, on, and on and on, It's really a huge diversity of research that falls under the category of clinical research.

16:21
OK, so more about translational, because this is really where the bread and butter lies.

16:25
This is really what's taking basic foundational science into the clinic and applying it to human health.

16:32
This is an image from the NIH, again, the National Institutes of Health.

16:36
So as you can see here, really, patient is in the center. So patient involvement is key and underlying translational research.

16:44

So starting over on the right. Again, we have basic research, feeding into pre-clinical into clinical research, clinical implementation. And then out in a broader sense to public health.

16:54
So the NIH really focuses on developing new approaches, demonstrating their usefulness and disseminating findings.

17:03
Just a little bit of statistics for you about NIH. So you've probably heard of them. In 20 20, their budget was forty one point six billion dollars, Which sounds like a lot. It is a lot of money.

17:14
But in reality, only about 20% of proposals for grant funding that go to the NIH are actually funded in the end.

17:22
So that 80% that's unfunded.

17:24
A lot of that is really good, important science, and there's just not enough money to fund it.

17:30
So we'll talk more about today how research is funded, but because the NIH, even though they're the biggest funding agency for biomedical research in the world, I think, we need other sources of funding for biomedical research. So foundations are really key to supplement the federal agencies.

17:49
I just wanted to show this not to drill into the fine details of this map here, but to show you how complex it really is to bring a treatment from.

17:57
the basic science, which is this yellow box here at the top, which really is foundational for all of it to occur.

18:04
But through all these other steps of target development, identifying leads for drugs that could be used in a clinical setting, all the way down to the FDA process, testing in humans, and then getting it out to market, It's hugely complex, and this is just an example of a small molecule drug and how it goes from basic research all the way to clinic.

18:26
So it is complex.

18:27
It requires a lot of money and a lot of time, in many cases, to get new treatments out. So we'll talk today how to find out about what type of research is happening currently that you might not have heard about yet.

18:40
But that might be coming through this pipeline and leading to new commercially available products, especially for peripheral neuropathy, which is difficult right now because there are really no good treatments, OK.

18:53
So translational research is often broken down into these different phases, So T zero, that's the basic research, Like we said, over and over, the basic research, gives us the knowledge that we need to be able to apply it to human health.

19:07
So, this is defining mechanisms, how things work, finding targets that might be targeted through a therapy or a treatment.

19:16
And, and identifying molecules, like we saw in the previous page, a molecule that might make a good drug or a drug target.

19:23
And T one is starting to move that to humans. So, proof of concept. When we're talking about clinical trials, this is phase one.

19:31
Then you're translating that to actual patients who have the disease or the disorder that you're trying to treat, or to better understand. And then, and T three phase that's actually moved into clinical practice.

19:43
And in T four, it expands out and is translated more, at a community scale, unhealthily globally, as well.

19:52
Underlying all of this are the phases of clinical trials. So, this is an FDA regulated process, beginning over on the left, with that foundational basic research happening in a laboratory, and then moving into the four phases of clinical trials.

20:06
And, as you can see in the graphic here, one of the key changes that happen as you move from phase one out to phase four, is the number of people that are recruited.

20:15
So in phase one, very few people are involved in those studies. This is really about safety, of the new treatment or medication.

20:23
Moving into phase two, you're adding how effective the treatment is into your study of safety. So you're increasing the number of people, because now you know that it's a relatively low risk intervention.

20:35
In phase three, you're now looking at the dose or the way that you're delivering the therapy, whatever it may be. So you're increasing again, the number of people.

20:45
And then in Phase four, this is more looking longitudinally. So long term, how effective is this? Are there any long term side effects? Does the dose need to be changed in the long term, et cetera?

20:56

So, again, you have even more people participating in a phase four trial, and throughout this process, the FDA's involved there's regulatory and compliance considerations. So, for example, any work done on humans, It underlies this regulatory body called, The Institutional Review Board or the IRB.

21:16
And we'll talk more about that when we go over ethics, but the IRB ensures that all of this research involving humans and patients is done in a rigorous and ethical way.

21:28
OK, so I just want to go over a few buzzwords.

21:30
And I'll re-iterate here that the Foundation is going to make these slides available to all of you, both through the recording of the webinar, but also a PDF of the slides will become available, because I know I'm going to have a few slides like this that have a lot of buzzwords and web links and things like that. But I just wanted to cover some of these key concepts, because I think we hear them a lot and not necessarily know what they are all about.

21:54
So the first one is collaborative research. So I alluded earlier to the fact that we no longer really have scientists alone at a lab bench working late into the night. Science is now a team sport. We work together in collaborative teams, both within a single laboratory, but also across multiple laboratories. Sometimes that collaboration is within a single institution. You might have, you know, and the clinicians collaborating with basic scientists, you might have engineers collaborating with clinicians, et cetera, but it also can happen across institutions.

22:26
So there are lots of good examples, even in neuropathy, research of collaborations happening across the globe.

22:34
And related to that is this idea of doing interdisciplinary research. So science, because biomedical is bringing in all these different fields, it's really become complex. It's sort of impossible to be a jack of all trades. So instead people tend to become very expert in their, their area of study and then collaborate with other people who bring in complimentary expertise and also work across disciplinary boundaries. So as I said before, medicine and basic research, working together, engineering and basic research working together, and that really strengthens the research team to bring people from diverse backgrounds and skill sets together to work on a single problem.

23:17
Research teams. So who are the people behind closed doors, doing all this research day in and day out?

23:23
It depends where you are, and what environment you're in, but this is just sort of a generic example, maybe of an academic medical center where people are doing biomedical research. So to start with, you have what's called a principal investigator or PI. We're not like Magnum PI. Unfortunately, we're just the people who bring in the grants, and they call us the PI.

23:42

So that can be, a lab had who's an MD, who's a PHD, who's an MD, PHD, et cetera. But these are really the people who drive the Research Program. Make sure the ideas are fundable, bring them to the granting agencies, Co-ordinate the work in the laboratory. Make sure that things get published. Communicate with the collaborative team, et cetera.

24:03
And then, within that team, in a laboratory, you have lots of different types of lab members. So, research staff, lab. Managers, if you're doing clinical trials, you could have a clinical trial office or a clinical trial manager working with you. If you're collecting human samples, you might have a biobank specialist who's who's keeping tissues and bio repository and on and on and on. It really just depends what research study you're looking at.

24:26
Then, we always have trainees with us, So, especially in an academic setting at a university.

24:32
So, residents and Fellows. So, these would be Medical Trainees, postdoctoral fellows. So they've received their PHD, but they're continuing on in their apprenticeship to learn more and become independent.

24:43
Graduate students working on a Master's or a PHD.

24:47
Undergraduate students are critical unsung hero of research, I have to say they're they're really critical parts of a lot of research teams, and of course, getting their training. And then sometimes we have Postbac trainees so people who have gotten their undergraduate degree, but they're getting some research experience before they move on to medical school or graduate school.

25:08
The next concepts kind of have to do with how the research is done. So, we have different types of studies, and as we're moving across the translational spectrum into human, sometimes, we have more and more of what we call correlational or descriptive studies because there's not a lot we can do or should do ethically to perturb the human system.

25:27
So you don't want people to come in, and, you know, investigate parts of your brain, you want your brain just to stay, OK. So a lot of those studies are correlational or descriptive. But those are important because those observations that come out of those studies are really important to drive a new hypothesis that might then go back to an animal model to investigate the mechanism and then back to human again to test an intervention. So those are still very important.

25:53
Then we have more experimental studies that tend to be done in a lab using a model system and these will perturb the system. So gain of function. So what happens if I make more of this protein or this protein becomes more functional?

26:06
What happens to human health, or the other side of the coin? What if I lose function? What if I turn off how this protein acts or turn off this gene? How does that affect human health and physiology?

26:17
So, those are more of the experimental types of studies. But really, we need all of these together, because they accumulate and complement each other.

26:27
The big myth, I think, about science is that we have successful results every single time. Nothing could be further from the truth. If you talk to any scientists, if anyone knows any. They'll tell you that day in and day out, we mostly are confronted with an experiment failing.

26:41
But we don't think of it as failure, because every single thing we do, we're learning and improving. So a lot of our days are spent troubleshooting and optimizing an experiment, validating our technique, or validating our model system. And then, we get to that beautiful day of Eureka, where you have a finding that you know is meaningful and impactful, and in some some cases, groundbreaking, as we see with all the Nobel Prize winning research projects.

27:07
So, that's an important thing to understand that a lot of research is toiling and figuring things out and tweaking it, and improving it as we go.

27:16
And lastly, a two important concepts are experimental controls and research reproducibility. So, a control is something that's not getting your treatment. So, if I'm testing a new drug, I'm gonna give it to some patients and then the other people are gonna get placebo.

27:32
In my lab, we call it the everything, but so if I had dissolve this drug in vinegar than the people in the control group, the placebo group would just get the vinegar. They wouldn't get the drug.

27:43
And that has really helped research be able to tightly control effects and not have these red herring's where it looks like we had an effect, but really it was the vinegar and not the drug.

27:53
And then research reproducibility is just the idea that you know one test subject is not enough, sometimes 100 test subjects is not enough, especially when we get into humans that are very diverse in their genetics and environment. So we want to reproduce with it, with a cohort of subjects, that's enough to be statistically relevant.

28:12
But we also want to reproduce across multiple studies, across, across multiple geographic locations, et cetera. So we really want to make sure that a finding is true inaccurate before it gets into the clinic.

28:28
Alright, so that was a lot of me jabbering, and throwing up a lot of words. So we're gonna break up the presentation now with another poll. So Tanya, feel free to throw up the next poll question.

28:39
So this one is, do you know how to locate the full text of a peer reviewed research article that's been published by a scientific journal? So for example, you might have heard on the news that a

new study came out about peripheral neuropathy and you want to find that actual study. Do you know what to do to find this?

28:57
So maybe, yes, you've done it before. You might have a slight idea of how to do it. You might know who to ask, or where to look to figure it out, or, you might have no idea, So, I'll give everyone a few seconds to submit their poll results on this one.

29:23
OK, all right, Tani, why don't we close this one, and see what our results are?

29:30
Alright, great, so 23% of you have done this before, that's fantastic. 18% are familiar, 20% would know where to go to find the answer, and 40% of you, I hope I'm about to give you some information that'll help you move up in the poll here. So let's head back to the slides.

29:50
OK.

29:51
Regained control here of the clicking, I think I did it.

29:56
Alright. So now we're gonna talk about this elusive process of publishing from the scientific angle going through the peer review. And then how do you, as a member of the public, or a patient, find this information, and get these research studies?

30:12
So, first of all, there are many types of research articles. They're not all the same.

30:17
As I mentioned before, sometimes there's a case report where there's just a single clinical case or a single patient that's reported in the literature. There's bigger studies done with groups of patients. There's studies done in those model systems that we referred to earlier, on all the way up to these meta analyzes, where someone's taking a bunch of data from previous studies and grouping it all together, and figuring out, if it's telling a cohesive story with the data. So, as we move up in, those different studies, were increasing, what we call the end value, so that's how many participants were in the study. How many subjects were investigated? Was it, 10 humans, are, 100, did we have five mice or 10 mice, et cetera. So this is the sample size. And this is what gives you statistical rigor. So a case report of just one person is not necessarily as reproducible, because that one person might be an outlier.

31:11
Whereas a meta analysis, because they're bringing in multiple studies and lots of groups of data, those have a lot more statistical, rigor, lot and a lot more likelihood that they'll be proven true over time.

31:23
The next thing to keep in mind is the journal.

31:25
So there are lots of scientific journals out there, and I'll show you some top examples in a minute. But not all journals have a good reputation for being rigorous about the peer review

process, or rigorous and what they choose to publish. So looking at papers that have a lot of citations, meaning other scientists, trust it and then put that in the bibliography of their paper. That's an important thing to keep in mind. But also the reputation of a journal, which sometimes is given by its impact factor.

31:55
So this is a calculation of how often people cite the papers that are in that journal.

32:02
The other thing to keep in mind is sometimes a study can't be reproduced or there's variability from study to study.

32:08
We hear a lot in the news about research findings that contradict each other or seem to have conflicting end points and conclusions.

32:17
That's very common, and sometimes that's happening because we're just looking at different populations, or different environments, or different groups with different genetics. And that can create the variability, and that's normal in biology.

32:29
Sometimes it's because of other things that a study wasn't controlled well enough, or the techniques weren't the proper techniques to do that research.

32:37
Or there was an error. Science tends to be pretty self correcting. So errors eventually get pointed out, and sometimes papers are retracted or corrected in the literature. But these are all things to keep in mind because just because you found a research study and downloaded it and read it doesn't mean that that finding is necessarily 100% reliable.

33:00
So maybe you've heard of some of these scientific journals, these are really the top ones in the world. So nature, which is published in England, science, published in the United States, cell, which is now a whole family of journals. and an, a very prestigious family of journals for biomedical research, And then things like the New England Journal of Medicine, or The Lancet, which are really the top journals where people publish a lot of clinical research.

33:26
So usually papers getting into these top journals. So these have the high impact factor.

33:32
Usually, those are reliable scientific studies.

33:36
So how do they get in there? What's the peer review process like?

33:40
I found this graphic, and I really liked it, I think it nicely shows, in cartoon form, how the pure peer review process happens. So, start out with the research study, scientists study it, and they write it up.

33:53

So, we have a traditional format of an introduction, materials, and methods section that explains how we did it, A results section, where we write about our findings, and show the data and figures.

34:05
Then a discussion at the end, where we talk about the implications of the findings.

34:09
So we write up that paper as a team, There's usually lots of authors on that paper list, then it gets sent to whatever journal we think would be a good home.

34:19
And sometimes this process is long, where we send it to a journal, they're limited on what they can publish, or the peer reviewers are critical, and we have to send it to another journals, so that's very common.

34:28
So the journal editors who chooses whether or not something goes out for peer review, Some things are desk rejected at that point.

34:35
And also who the peer reviewers will be, and how many of them.

34:39
So traditionally, there are three peer reviewers, They tend to be people who are expert in the field, who are actively doing research and publishing in the field, and so they should have the best ability to critique and comment, and suggest improvements on the paper that they're reviewing.

34:54
So the reviewers read the paper, and they give their feedback to the editor.

34:58
The editor decides are we going to let these authors fix up their study and resubmit it?

35:05
Or are we just going to rejected at this point? And sometimes this cycle goes round and round a couple of times, where you revise your article. Send it back in.

35:13
Reviewers, look at it again. They say, OK, good improvement. I like where you're going here. But I've got a couple more suggestions, and then it will come back to you to fix it up again. And then, eventually, if your article is accepted, you'll see it in press. In one of these journals, and what's nice, more and more these days, is that a lot of these journals are publishing their papers online. Not just in these printed, no actual magazine style journals, where you have to go to a library to find them. So it's easier to find things online.

35:43
And while a lot of them are behind Paywalls, so these journals are for-profit entities, still.

35:49

So you do need a subscription in a lot of cases, but more and more researchers pay a higher fee. So we all do pay to publish, to get our papers out in print. But we can pay sometimes a higher fee to make the journal open access, to make the article open access.

36:06
So when you're using Google to find articles, what you're really searching for, what the top hits will be, are these open access articles that you don't have to pay or have a subscription to get access to.

36:18
So that's something to keep in mind, and we'll talk more about that.

36:22
OK, intricately connected to publishing is funding. So the cycle really is, you have to publish to be able to be competitive for funding. You need funding to pay for the research, so you can publish. So it's really, you know, a cycle that's intertwined, and we need, We need both things to be successful and active as scientists.

36:43
So funding tends to come from several different sources. The first and probably the biggest is the federal agencies.

36:50
So the National Science Foundation, the National Institutes of Health, the Department of Defense also funds a lot of biomedical research, especially as it relates to the military issues. And then there's foundations and non-profits. So I've shown here the American Diabetes Association. But places like the foundation for peripheral neuropathy are starting to fund research. There's lots of different foundations, usually around specific diseases or disease processes that provide funding to researchers.

37:21
And this really is a critical supplement, because I told you how competitive it is.

37:25
Even good science doesn't get funded by the federal agencies, unfortunately.

37:30
And then if you're at a university or a research institute, another source, for research funding can be donors. So there are private donors who give money, sometimes to a certain research topic, sometimes just to a certain discipline, and that's really critical to keep the research engine going as well.

37:47
So how does it all work? Similar in a way to publishing. So funding requires writing and submitting a grant proposal. Sometimes these are massive documents.

37:57
They take sometimes a year to prepare because you need to show a little bit of data already to show that your idea's good and worth pursuing and worth funding. And that gets reviewed and scored so similar to the peer review process. So you might have three people reading and scoring your grant critiquing at, determining if it fits the mission of the funding agency, determining if it's worth, in some cases, taxpayer dollar investment.

38:22
And these pay lines are really competitive.

38:25
So all of us who are writing grants are also acting as reviewers of grants, as well.

38:30
That's part of our service to the scientific community.

38:34
What's nice is all of these funders hold standards for data management, research, rigor, research ethics. How do you manage personnel in your lab, especially the trainees.

38:44
A lot of them require training plans, and we have to report and show that we've been productive with the dollars we were given, and actually, you know, contributed new knowledge to the field.

38:55
And, lastly, there are smaller grants. So sometimes they're called seed grants or pilot grants. And these are really essential sometimes to get a new project or a new idea off the ground and show enough feasibility for these larger grants, coming from the bigger federal agencies. So that's, that's a critical thing, Sometimes a grant of 25 to 50,000 can make all the difference to get a new idea off the ground.

39:20
Grants can sometimes fund one year of research or more, depending on the scope. So a typical NIH grant, the big procedures, one is called an R oh one. That's a five year grant, somewhere between, you know, 2 or 3 million in a lot of cases.

39:35
But that has to pay for a lot of people to do the work, as well as research supplies and equipment and all of that.

39:41
OK, I had to talk today a little bit about some of the safeguards, because I think that's an important thing about the scientific process that a lot of safeguards are in place. There's a lot of self correction and peer monitoring, as you've heard today.

39:54
So I wanted to talk about research, rigor, and research ethics.

39:58
So really, the two tenants underlying these safeguards are research integrity. So the way that we're all trained to carry out the research in a way that's reliable, transparent, and ethical, and also research rigor, so that's designing the studies in the right way, using the correct number of sample subjects. So our data can be meaningful.

40:18
Everything that goes into conducting an experiment in a way that leads to a result that can be publishable and reliable responsible conduct of research. Is it standard training that's done when people join a laboratory? A lot of universities have offices dedicated to this concept. A lot of professional societies also have codes of conduct that touch on responsible conduct of

research. So it is a very common aspect of training for everyone working in a laboratory or working on research.

40:50
This is just one example of one of the guides. So, this is created by the National Academy of Sciences on responsible conduct of research.

40:58
And this is just a word bubble covering some of the topics that get covered in these trainings.

41:03
So, things like professionalism, um, data management, informed consent, research, rigor, and who are the participants in the research? Is their fieldwork, are their protocols, what's the safety, et cetera. Those are all covered.

41:19
And, especially as it relates to the clinical research. So, for testing something in human, or using human samples, or human subjects for research, there's a whole separate IRB regulated aspect of this medical ethics. And this includes informed consent. So, when you're taking part in a study, there will be a document that outlines all these aspects of an informed consent. So, what are the benefits to you? What are the potential risks? What if it's a treatment study? What is the treatment? Are there alternatives? And then there's always time for participants to ask questions. So this didn't exist several decades ago, and this is really a nice thing that's evolved over time, and the research community, that there's much more oversight and regulation and how research is done with humans.

42:07
OK, on that note, let's do our final audience poll.

42:16
OK, so how comfortable do you feel vetting scientific information and determining if it's reputable or not? So do you feel very comfortable figuring out if Science News is reliable, or do you feel only a little bit comfortable.

42:32
Give everyone a few seconds to click your answers here, and then we'll look at the results.

42:43
OK, Tanya, I think we should be OK. Now, probably everybody's familiar with the polling at this point. OK, so, 17% feel very comfortable, 1.45, respectively, are Somewhat are a little bit comfortable and 12 Not at all. Great. So let's talk a little bit more about this. We can go back to the slides.

43:07
See, I click, there we go. So when I'm teaching students in the classroom, I use this term, caveat and tour, which means buyer beware. And I think all of us, when we're consuming information, we need to have this mindset of buyer beware.

43:23
So, the first thing is know your source. Where's the information coming from? And in these four boxes right here, I think we have the key reliable sources of scientific and medical information. So the first is scientific organizations.

43:37
So, the triple AAAS is the non-profit society that publishes that research journal called Science.

43:43
So they are really a go to source, and I'll show an example of their news website in a minute.

43:48
The NIH itself produces a lot of news, scientific publications, So it could be research articles. It could be science, news, etcetera. Professional bodies, so major research hospitals, scientific societies, research universities. And, of course, going right to the source, to the trained and practicing experts themselves.

44:09
If you ever want to look for your own research study, or if you read about one in the news, and you want to find the actual full text of it.

44:18
The goto site for biomedical articles is called PubMed. I put the URL up here and this is just a screenshot of what happens when you search for something like peripheral neuropathy. So I type this in and click search. It gave me, let's see, over 17,000 results here. So this is going back as far as these articles have been maintained in the database, so long time. And then it's going to show you some of the most recent editions, up top here. And what I really like is looking at this bar graph on the left. So starting from 19 34 to 20 22, the number of articles published per year on this topic. And I hope this is re-assuring to all of us that we're seeing way more publications coming out with each passing year on this topic.

45:04
But, anyway, this is where you would click on the title, and you could gain access to the full text of the article. If you can't get access, your local research library could probably help you. A lot of them share through interlibrary loan subscriptions to these different journals, but some of them, like I said, are open access. Meaning, anybody can get them and get the full text, and the easiest way to figure out which ones are open access.

45:29
It's by using Google Scholar.

45:31
So I've just gone into Google Scholar here, and typed in peripheral neuropathy. I get about a million results because it's not just the articles in PubMed, so I get more than PubMed. But here, it's a different algorithm, so it's not just showing me the most recent publications.

45:47
It's showing me the most popular, the ones that get clicked on the most and those tend to be, as I said before, the ones that are free that are not behind a paywall or a subscription. So check out both these resources, if you haven't already. Type in some keywords that are of interest to you, and just, and see what you can get access to.

46:07
OK, so this slide is gonna be a little bit wordy as well, but you'll all have access, so I'll go through it a little bit quickly, but I do want to cover, how to find, and also that, the research.

46:17

So, I already said, look at the source, but also look at the intent behind sharing the information.

46:23
So a lot of dot com websites that look like they're sharing scientific information are often selling a product that makes them a little bit biased, in some cases, they might not be sharing those accurate or complete scientific information.

46:37
So think about is the goal of this source to disseminate reputable and current current evidence based information, even when you're on PubMed, which is the go to source for these articles. Not all the journals there are peer reviewed or reputable.

46:53
So, there are some journals that we call predatory journals that are for-profit.

46:57
They prey on researchers who really just need to get their research out and they don't have a very rigorous process for peer review and so those are journals to stay away from. But even in the really nice, peer reviewed and reputable journal, not all studies are great, unfortunately. So not all are well designed or well executed, and not all peer reviewers are created equal as well.

47:18
Everybody's busy, and we don't always, you know, get things through a very tight net. So that's just something to keep in mind.

47:24
The system is very good in general, but you still have to have that caveat MTOR mentality.

47:31
And then, of course, over time, not all studies are going to be reproduced and hold up with further study.

47:36
And some other caveats, to keep in mind as you're looking at the primary research literature is low sample size. Sometimes this can show a significant result that doesn't hold up later when you get them bigger.

47:47
Sample size: sometimes model systems don't always apply to human health, They're largely relevant.

47:54
Of course, that's why we use them, but not everything is going to perfectly translate, um, some more reliable sources.

48:00
So Twitter, actually, any of you who are on Twitter, a lot of scientists and doctors are on Twitter, and they're Tweeting their work.

48:10
So, it's actually a great place to engage directly with people.

48:14

Science communicators, and journalists are also on social media and will directly share information. So you can follow a lot of them when you find a good one, who's who's covering your topic really well. It might be worth looking them up and following there for their future articles. And then universities have their own press. They have their own research publications, their own research dissemination offices.

48:34
Hospitals, oftentimes, especially the big ones like Mayo and Cleveland Clinic, have newsletters that share research information.

48:43
And if you really are in it and want to know what the current cutting-edge research is happening in your field, then following the scientific and medical conferences is really the way to go. So people will always scientists will always present their work to their peers at these meetings before they publish in a journal.

49:00
So often, sometimes there's news coverage, or posted talks that are free for anyone in the public to see. Or if you're really interested, you can register for the conference as an attendee and see the current cutting-edge research that's being presented. And then I'm going to show you how to find grants that are currently funded. So you can see if your area of interest have has active projects that are ongoing, and whether or not there are any clinical trials relevant to your interests. So, to find grants at NIH, there's a tool here called Reporter, it looks like this when you click on it on the Internet. And then you just type in the search bar, you could type in peripheral neuropathy, you could type in chemotherapy induced neuropathy. You could type in idiopathic neuropathy and it's going to pull up for you.

49:47
I think I have an example here. Oh, no, that's clinical trials, OK? So it'll pull up for you a result list of results of all the different active, NIH funded grants that meet that keyword.

49:58
So that's a great tool. And then to look for current clinical trials. This is where you go.

50:04
This is again part of the NIH, but this is clinical trials dot gov, and here I've typed in just neuropathy.

50:11
and right now there are over 2500 ongoing clinical trials within this topic.

50:18
And you can see here that some of the thing completed, which means: keep your eye out. They might be published soon.

50:23
Some are actively recruiting, some are not yet recruiting. And then, you can click on the name of the study and learn more, especially if you think you might want to become a research volunteer. That's a great way to learn about how to be involved in the research.

50:35

I'm going to skip this in the interest of time, but this will be on your slide deck. This is just more information about vetting on science news sources that I shared with my students in classes.

50:46
I'm gonna give you a few examples of reputable sources. So, the first one, science daily, how do we know it's reputable, reputable? Well, it's telling you right here, the study was published, when was it published? What journal was it published in?

50:59
That's a key way to figure out if science news is reputable.

51:02
If it is, if it shows you the actual citation for the research that underlies the claims and the headline because sometimes the headlines do oversimplify, so we have to keep that in mind.

51:13
Here's another example. So this is triple AS that foundation that runs the journal science, that they do a news entity called Eureka Alert. Also, very reliable. How do we know this is not bogus while they're talking right here, but an NIH funded study? They're talking about where these scientists are doing their work at Temple University. So these are key things to look for, so that you know that this the news is reputable.

51:38
And lastly, this is another example. So this is a professional society. So this is the American Association of Neuromuscular and Electrode Diagnostic Medicine. That's a mouthful. But again, they're showing you the citation right here at the top of the article.

51:51
But they're really doing a service for you as a science journalist by breaking it down and giving you a really digestible version of a scientific article, which otherwise would be sort of dry and tough to navigate. But by doing that, sometimes these headlines are misleading. It might make it sound like a new treatment is a golden bullet for something, but it isn't always so. Keep that in mind. Caveat MTOR.

52:16
OK, I'm gonna end with three quick examples of current research going on in neuropathy going basic to translational to clinical. These are three examples of hundreds and hundreds and thousands that are going on right now.

52:28
So, the first, just to give you a small taste of what we do in my lab, we do basic neuropathy research into translational. We're looking at things like genetics and the immune system, and how those play a role.

52:40
And we're specifically interested in the neuropathy caused by diabetes, obesity, and aging, because those also impact our metabolically important tissues, like our fat tissue and our muscle.

52:51
We think there might be a vicious cycle where when you lose innervation of a tissue that worsens your metabolic control.

52:58

And we're looking at how immune cells, especially these neural immune cells that affect our nerves, might support nerve health.

53:06
And to do that, we're really interested in the genetics, so the diversity of genetics that can underlie your risk for these conditions.

53:13
But also, sometimes genetics within a family line can predispose people.

53:18
And to do that, we use mice as a model. So we can use a genetically identical mouse that might represent a single risk factor.

53:26
So these mice we used to look at diet induced diabetic neuropathy.

53:31
There's other mice that are very, very prone to neuropathy because they have a mutation in a certain gene.

53:37
And then there's other mice that more represent humans because they're more genetically diverse, and we use this type of mouse called a Hat three to represent aging related neuropathy.

53:48
So this is just one example of how basic research can be done.

53:52
and the neuropathy area.

53:53
The next one is looking at translational research. So this is Sandra Reiger, she was at the MDI Biological Laboratory now at University of Miami. She's looking at chemotherapy induced neuropathy and new therapies. She's identified.

54:07
And then P 13, which is an enzyme, breaks down collagen. That can be bad in our tissues, and looking at that as a drug target. And this is really exciting to me. Cassandra's gone the full spectrum. So her research started in the zebrafish model, went into a mouse model, and then into humans. This is an example of one of her recent publications looking at this new drug target.

54:31
And this is also an example of what can happen, that there's eventually commercialization. So academic scientists can form a company, or license their technology, so that it's getting out there to patients.

54:43
And this is one example with Sandra's Research.

54:46
I'm going to end with Eva Feldmann so this is a fantastic researcher to follow. If anyone's interested in Diabetic neuropathy she's at the University of Michigan. She does the full spectrum of basic to clinical research and she's also on the Scientific Advisory Board for the Foundation.

55:02
So, this is a recent paper where she's identified that lipids, not just sugar so a lot of people thought that it was the glucose, the sugar that was causing diabetic neuropathy but she's found that it's actually the lipids and they're impacting the mitochondria inside the nerves. So the mitochondria are the energy powerhouse inside.

55:22
I was hoping we'd have time to show a quick video of Eva, but I think probably Tanya and Lindsay, we might want to skip it and just send the URL to everybody for the interest of time because I really want to be able to field some questions here. So. So, thank you, everyone.

55:36
And I look forward to hearing any questions that anybody has and switch it over.

55:43
Well, thank you so much for your time, Kristi, and yes, we can definitely share the video with everyone following this session.

55:53
We have had plenty of questions that came in, so I'll try to address appear. We might go a few minutes past the hour. I hope that's OK for those.

56:02
Still stay with us, please. Please do so.

56:05
Um, so, what is your thoughts about someone who wants to join a clinical trial, but in doing so, they might have to go off of a drug, for example, That allows them to no work life, and without the drug, they might have enormous amounts of pain.

56:23
For example, how would you help someone balance what their duty is, and if that's something that they should try to proceed with or not?

56:33
Yeah, That's a great question.

56:34
So sometimes there are limitations in who study can enroll based on their preexisting conditions or medical issues they might be on, So that could be something that, it puts you out of the running to participate, But I would not take that lightly. So I think informed consent would definitely educate you on the benefits and the risks of participating. But I would not go off of medications, or take part in any clinical trial without consulting your, your regular doctor and making sure that they're involved in the process.

57:04
Out of curiosity, what is the state of research on stem cell therapy when relating to peripheral neuropathy? Great. Question. So we do some stem cell research in my lab, actually, but more in the brain. So. So the tough thing with peripheral nerves is that the cell bodies so the part with the nucleus and the DNA and everything that's controlling the function of the cell those are up in our ganglia in our spine.

57:28

So a lot of people think that these cell bodies are out in our tissues, and out in our skin and everything, and they're just not.

57:34
So if we were going to use stem cells to make a new peripheral nerve, they would have to somehow be integrated, in our ganglia, and then grow out these long axons that reach into our tissues and organs and out to our skin.

57:48
So, I'm skeptical right now, as someone who's in the research field, I think there's a lot of, um, risky stem cell clinics out there right now, that I would be very talking about, Caveat. Emptor Look very carefully at those, before believing any of the claims do some of the research, like we talked about today.

58:08
So I think that stem cell therapy is going to be incredibly powerful for a lot of diseases. I think we're in early days, in a lot of cases.

58:16
And I think there are some sayles claims out there right now that are potentially dangerous.

58:21
So, so, be careful.

58:24
What about gene therapy?

58:26
Ah, That one I think is further ahead. So actually, my next door neighbor here at Ohio State is one of the pioneers of gene therapy for things like Parkinson's. I think this is hugely exciting. We're going to try and move in that direction with some of the therapies we're looking at in my lab. I don't think we're there yet, of course, for peripheral neuropathy. I think we will be definitely a space to watch if you're following the research literature.

58:52
What do you advise readers? And even myself do when we're looking at bonafide publications and they're contradicting each other. Yeah, so he sort of almost could make a list of why are they contradict each other. And it sometimes can be a fun exercise in the lab. So look at their model system. What were they using? Wasn't human tissues? Was it cells in a dish? Was it a mouse or a rat or a monkey? Like just look at what the source of the data was? And look at what their approach was? So, were they doing a drug treatment study, or were they doing something more to look at how things work, and the mechanism of the cell, or the molecules inside the cell? Those things make a huge difference in the result. But then, of course, we're all trying to publish the story of our data and sometimes the title, the abstract, can oversimplify the complexity of the data within the article. And then, you go to the news, like the examples I showed you today, the Science News. And they're going to simplify it even more and make a headline look like.

59:52
There's a definitive answer, but, but really, unfortunately, most research studies, even though they have a conclusion at the end, take it always with a grain of salt. It takes time for studies to build up enough cumulative evidence to have a definitive answer.

1:00:08
So, speaking of how long does it take to create a mouse model?

1:00:12
Great question. So mice are, I think, a wonderful tool because we first of all have amazing humane research facilities where animals live in a research lab space much longer than they live out in nature, where they're being hunted by cats and things like that. But, so, that part's wonderful. They live around 2 to 3 years, so we can get and reproductive cycles. We can see multiple generations. That's important for genetics. But to generate a mouse, that's that's a tool in terms of, like, it's lost the function of a protein or a gene.

1:00:42
So we can study that protein or gene that can sometimes take a couple of years to develop a new model for that. So it is slow and time consuming, and expensive.

1:00:52
But they're a powerful powerful model. A lot of their peripheral nerve function is very similar to a human.

1:01:00
So the foundation for peripheral neuropathy, we have a biobank of human plasma, DNA and serum samples.

1:01:08
The only biobank that covers peripheral neuropathy patients.

1:01:13
And I'd love to kind of have you maybe do a couple of minute walkthrough for patients to better understand, really the importance of what this research registry could view as far as treatments, and learning a little bit more about what is peripheral neuropathy so that we can get more answers and maybe one day find some cures.

1:01:35
Yeah. So first of all, I encourage everyone to visit the Foundation's website, which will soon I think will be relaunched. And it's a great walkthrough of this resource and the many academic medical centers that are partners with the Foundation to collect these patient samples. So, I think it's just, you know, this huge enterprise. That's really exciting. So, with these samples And in my opinion as a scientist I think there's a lot of power in unraveling some of the genetic risk factors that might exist. So, when you've got a DNA sample, you can look at people's genetics. We, my understanding is we have a lot of the clinical data, as well, to compare to that. And then things like CRM and plasma samples from the blood might have biomarkers that could potentially be identified to better diagnose.

1:02:18
I know diagnosis in a lot of these cases is really difficult for patients to get a definitive answer. So if we had a good biomarker for chemotherapy induced neuropathy or a better biomarker for HIV induced neuropathy, that could help speed up diagnosis.

1:02:33
And then, of course, once you understand all these mechanisms and all these descriptive and correlational aspects, then you can start to conceive of a hypothesis for a potential treatment that could then go back to a model system, can be investigated, and studied in that way.

1:02:50
And when you know when a treatment is proven to be safe and effective for pro bono rapidly, obviously, we always encourage patients to consult their primary care physician to make sure that it fits well within their own care plan.

1:03:04
But if it's been published or not been published, does that matter when it comes to whether or not this is something that a patient should consider taking to treat a symptom?

1:03:14
Yes, definitely, always listen to your doctor. So, unless you're taking part in a trial, then you would not be prescribed something unless it has gone through that whole FDA process of phase one, phase two, phase three phase for testing. So, I think that's really important, is to listen to medical professionals when it comes to that, because people are going to publish all along the way. So, even if Phase one, we've got very small numbers of people, and you're mostly looking at safety, that can be published. And so, that's exciting. I mean, that's a potential new therapy that could be coming onto the market at some point, but it doesn't mean it's ready yet.

1:03:51
And what is your recent reaction to the the recent Nobel Prize for researching and identifying?

1:04:00
The trip channels, yes. So the TRP transient receptor potential, the trip channels, those are exciting things in the body I have to say. We do a little work on them as well. So those are on your peripheral nerves. They can detect things like heat or cold, or certain chemical compounds. I mean, they're really, I think it was deserving of the Nobel Prize. So it's not just paying those trip receptors. those channels, they're actually calcium channels can do a lot more than just sense pain. They actually are functional and tissues that don't even feel pain. So we look at them, and the fat tissue, which doesn't feel pain, so I think it's exciting, but clearly, and especially for this community, we need more pain research, in general, we need better alternatives and pain treatments that are non addictive and more efficacious in the long run. So I think it's exciting that the Nobel Prize sort of shown some light on that area of research.

1:04:53
Christine, and before we wrap up, one final question, which is, what excites you the most about neuropathy research, specifically? Either what's currently happening or what you see in the future, what should a patient really be hopeful for?

1:05:09
Because that's obviously something that we here at the foundation for peripheral neuropathy, you're trying to instill hope, knowing that our patients are struggling every day?

1:05:18
Yes. So, for me, it's one word. and that's plasticity.

1:05:22
So, the peripheral nerves are plastic.

1:05:26
We always hear about neuropathy reaching this point of no return where they probably can't regenerate our grow out and re-integrated tissue any longer. And that might be true, in some cases, but I think we just haven't quite crack that nut.

1:05:38
And I think there are going to be therapy interventions that are identified that can help hulks a nerve to regrow its axons and ..., to restore, you know, healthy innovation. So I'm an optimist. Of course, that's why stick with science even on the rough days. But that word plasticity to me is what gives me a lot of excitement and hope. I think these nerves can and will be coaxed into plasticity someday.

1:06:02
We just have to keep chipping away at it.

1:06:05
No, that's great.

1:06:07
Know, obviously, here at the Foundation, we're also chipping away, right? Our research registry is dedicated for diabetic idiopathic and also HIV slash aids.

1:06:17
So, we are collecting samples. We're trying to learn as much as we can about those types of neuropathy. We are also funding what's called the Imagined Study, which is for anti may neuropathy, currently recruiting patients for that study. If anyone has anti may, please feel free to reach out to us here, and we can point you in the right direction.

1:06:40
But there are a lot of really exciting studies happening.

1:06:44
Obviously, the NIH, the DOD, is also very integral in funding outside research. You had previously suggested gas.

1:06:53
The Foundation is going to start funding grants to these entities so that we can actually start funding outside research that will be integral in finding more answers. So, we're really excited about it.

1:07:06
And we kind of just have to be patience and take some time before we can feel more competent and releasing some more information.

1:07:15
Christy, this has been so helpful. I've actually found it extremely helpful. I'm sure a lot of our patients have as well. So, again, thank you so much for your time today.

1:07:23
Thank you for serving on the board of the Foundation as well. We're lucky to have you. And we're lucky to have everyone that currently is watching, and we'll be watching the recording of this webinar.

1:07:35
We encourage everyone to take the survey that's going to follow. It'll allow you to give us great feedback so that we can make sure that we're addressing all of the concerns that, that you, each of you have on a regular basis.

1:07:49

We ask that you continue to support us, especially in year ends. If you haven't yet made a gift, we, we encourage you to do so. These are the kinds of educational programs that we'd like to do, And without your support, we really can't do them.

1:08:04
And, we're here, we're always here, So feel free to e-mail us, feel free to call us.

1:08:09
And, again, thank you all for joining today's session, and have a have a good rest of your day.

1:08:19
Thanks, everyone.

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