Transcript Details
This is a transcript of an educational program. Details about the program and additional media formats for the program are accessible by visiting: https://reachmd.com/programs/the-convergence/humanoids-healthcare-surgical-expertise/67128/

ReachMD
www.reachmd.com
info@reachmd.com
(866) 423-7849

Humanoids in Healthcare: Extending the Reach of Surgical Expertise

Dr. McDonough:
Welcome to *The Convergence* on ReachMD. I'm Dr. Brian McDonough, and joining me is Dr. Michael Yip. Michael, thanks for being here.

Dr. Yip:
Thanks for having me.

Dr. McDonough:
To get us started, tell me a little bit about yourself. What brought you into robotics and specifically into the operating room?

Dr. Yip:
I'm an engineer by training, and one of the things that really drove me to get into engineering was this idea that you can go from ideas from a paper napkin or scratchpad all the way to a finalized product. And one of the areas where you can do that in a way that you can see the whole process through is in medical devices and medical robotics. So if I look at certain engineering fields, I had originally wanted to start out in doing aerospace engineering, and I was really interested in that type of high-tech, deep-tech kind of development. But in those fields, you spend all of your time focused on one little part of an enormous system, and instead, if you look at medical devices, it's really small teams that see the whole process through. And that's how I really got started and what drove me into it. So I did my engineering degree in mechanical engineering, then electrical engineering, and then finally, as I understood and got much more interested in biomedical engineering, I did a degree in bioengineering as well.

Dr. McDonough:
What a great background, and it has to be helpful, I'm sure. Now, you direct the Advanced Robotics and Controls Laboratory at UC San Diego, where the work spans surgical robots, humanoid robots, and robot learning. How do all those areas connect?

Dr. Yip:
Yeah, this is a great question. So at UCSD, I'm a professor in electrical engineering. But realistically speaking, as you were touching upon, it's really drawing from a lot of different fields, the type of research we're doing. And so when we look at what's out there today with robotics and what the needs are for the healthcare problems that our society is facing, there's a lot of aspects of how diagnosis and treatments are done that can use ideas from software development, automation, and AI, and also to robots that actually physically interact not only with people, but are also interacting through surgeons as surgical robots as tools for them to use in the operating room. So we look at the gamut of building robots, from providing them with AI to then doing systems that provide things like remote teleoperation to even autonomous assistance in an operating room.

Dr. McDonough:
Now, you have been working on robot autonomy for 10 years or so. Tell us a little bit, what did the field look like when you first started, and what has changed the most?

Dr. Yip:
About 10 to 15 years ago, if I were to go and talk to doctors about how they felt about the rise of surgical robots and especially autonomy, I think there was much more reluctance. There's still reluctance today, but there was much more reluctance about what that could mean in the future for the state of healthcare and the practice of medicine. And so that's from a social perspective.

From a technological perspective, robots, even 15 to 20 years ago, were very physically capable of doing very precise, sub-millimeter

precision maneuvers. And so robots have continuously been designed to offer new types of interventions. But what really has changed is really in the AI and the automation side of things. So back then, it'd take a lot of effort to engineer something that could autonomously move around and provide some assistance, like holding a surgical camera steady. Nowadays, with the technology stack that the modern AI methods provide, it becomes much easier to engineer newer forms of automation and guidance.

Dr. McDonough:
I know a lot of people have this question, but I'll get it out in front of you really quickly; is your goal to build robots that replace surgeons, assist surgeons, train surgeons, or some combination?

Dr. Yip:
This is a really good and important question. I think we always look at what the needs are of the patient population and the healthcare professionals. And so there's a couple of ways to look at robotics and AI-driven robotics and automation. I think one of them is to not look at it as replacing doctors, but to see that surgeons, doctors, and staff are struggling to even schedule enough operations to meet the demands of the populations that they take care of. And they're not necessarily even providing access to folks that are outside of their local regions, right? And so from that perspective, instead of looking at it from replacing professionals such as surgeons and nurses and so on and so forth, we're trying to provide augmentation on their team. So it's like robots working with smaller teams of nurses and doctors to provide care in situations where they might not have enough expertise or enough of a team to provide that care. And I'd say that's one of the ways to look at it that's really important.

Dr. McDonough:
So if I'm following you, essentially, you're saying there, which we all know, there is a need for more healthcare providers—physicians and others. This may be another way to help fill that need and maybe bring care to more people. I mean, on a much smaller level, we're seeing that with telehealth. We're able now to get to people who are in remote areas and provide maybe not person-to-person care, but person-to-person interaction through a screen.

Dr. Yip:
That's right. I think that robotics is going to be an evolution as well on the telehealth side. You can only do so much through audio and video, and to not only be able to physically interact with patients through a robot avatar onsite, but also interact with equipment in the room to interact with other doctors or nurses or staff, that's going to be an enabler of the types of procedures that can be done that you can't do today with just today's telehealth approaches.

Dr. McDonough:
Similarly, the most credible way to frame this is robots as assistants, collaborators, and trainers—basically scalable extensions of surgical teams—is the way we should be looking at this?

Dr. Yip:
Yeah, exactly. I like to frame it as a technology in which it can be an avatar for yourself in a remote location, or it can be a technology where it completes a surgical team, where it can provide independent assistance or be tasked with jobs that otherwise you might not have the staff to do.

Dr. McDonough:
There’s a couple of terms I want to go over with you that come up. One is “robot learning,” and the other is “humanoid platforms.” Can you explain how you understand, first of all, robot learning? When you say that, what do you mean?

Dr. Yip:
Yeah, so for robot learning, the idea is that you are trying to teach a robot a type of skill, right? And that skill can be very generalizable in how you approach it. But let's just take an example of suturing. You want to teach a robot how to properly suture a wound. So the standard approach today is to provide demonstrations of how to suture a wound, typically through teleoperating the robot. And let's say we take the da Vinci robot as an example of a very common surgical platform. So you would actually operate the da Vinci robot and teleoperate it to do the stitch. And then the robot learning aspect would be seeing a couple of these stitches being performed and getting the trajectories of how to do a stitch and throw a needle, and basically being able to replay back that type of behavior. That idea of demonstrations and then converting them to replaying those demonstrations in the context of what's happening in the scene is the foundation of robot learning.

Dr. McDonough:
And what about humanoid platforms? That really sounds futuristic.

Dr. Yip:

Yeah. So humanoid platforms got very popular in the last two or three years, and the reason for that is the scale at which they were being manufactured and the quality of the software behind them had become very good and much more resilient and robust. But the idea of humanoid robots, which basically look like human bodies, has actually been around for decades.

The first humanoid robots that probably have become more popularized amongst general audiences would be the Honda Asimo robot. This was something that came out in the early 2000s, right? So we're talking about over 20 years ago. And this was a bipedal walking robot with hands, fingers, heads, and so on and so forth. And so that technology has been around, and just today it's become really in the mainstream because the ability to build robots at scale at low cost and the software stack behind it means that a lot of people can access and reprogram it to do things.

And for example, in my lab, we're very keen on showcasing humanoid robots as a technological platform that can walk into an operating room and interact with everything that's already there instead of having to redesign an entire operating room to just meet the needs of one machine.

Dr. McDonough:
When people hear the term “surgical robots,” I think you're giving a good explanation explaining how you deal with it, but what kind of tasks are hardest for robots to learn? You mentioned da Vinci, and that's what I think most of us have seen. Not every hospital has da Vinci. It's expensive, but I think we have seen how it works, and the arms are in there, and it's helpful. But that really is almost just like an extension of the surgeon's hands to a large extent. Is that what we're talking about, or is it greater than that?

Dr. Yip:
I think that's really been the status quo for so many years. There's robots, most of them being minimally invasive and mostly laparoscopic. But that's been such a status quo of what we think about surgical robots that it has pigeonholed the idea of what surgical robots can mean for a long time. But today, I think it's a really wide-open field. We can look at flexible endoscopic robots that are endovascular in nature. We can look at needles that are self-steering for things like biopsies or therapy. And we can even look at newer technologies, though not commercialized, but like I mentioned, humanoid robots, that interact at a level that's a bit more abstract. So again, they can operate equipment in the room, or they can hand off tools to a surgeon or so on and so forth. And generally speaking, that's the evolution of things that have happened in robotics.

Dr. McDonough:
So at UCSD, when you're in the ARC Lab, when you're in these labs, a lot of us have just seen recently, I think in China, they were having these robot games where we saw these robots running in their Olympics and things like that. Are we talking about standing robots that will be standing next to someone, or is it still more the hands going in as an extension?

Where are you now in your research?

Dr. Yip:
So we are very interested in kind of the really far future idea of what it might mean to work in a robot-human team. And so because of that, we're really interested in this idea of humanoid robots that have human-like hands picking up regular surgical or technical tools and actually interacting with other doctors or the patient and performing procedures. That's the vision. One where a robot can be told, "Hey, can you adjust the surgical lamp?" And they'll put down the tool and reach up and adjust the lamp. Or “Can you check on this machine?" and they'll go and interact with the electronics of that machine. That's what we are very focused on, and part of that then means that we should be looking at robots that have the flexibility to walk around, step over cords, and not get constrained by a wheeled base. So yes, we are very keen on examining legged platforms, but we understand the path to get there in terms of translation is to start with wheeled platforms.

Dr. McDonough:|
When you say autonomous surgical robot, am I right in picturing a robot doing an entire operation by itself? Is that a goal?

Dr. Yip:
That is not an immediate goal today. An autonomous surgical robot, in my vision, is always to look at what is truly required and what is truly helpful in the actual procedure. And a lot of that actually comes down to looking at segments of a procedure. And again, I'm not a surgeon, so I'm just relaying what my colleagues say to help inform me and my team and help craft what we're doing. But the idea is to look at procedures and pick out areas where you have either long, tedious tasks that could be automated that you could assign to a robot to do that frees up not only the surgeon's time, but also relieves them of the stress of performing for hours and hours on end. Focusing on snippets of a procedure is really where we think that autonomy's going to get rolled out first. Maybe it's going to be like closing up a wound, right? Maybe it's going to be ones where you're trying to access deeper tissue, and the robot is going to provide some of the dissection of the connective tissue to a certain point.

I think one thing that is important is that everything is crafted with a vision towards making it very safe. And the idea of providing algorithms and approaches that can recognize when something's unsafe and hand it back off to an expert is the idea. And that's really why it's not going to be the entire procedure. It's going to be segments that are easy in the sense of performing the actions that might just be long, tedious, and straining to perform.

Dr. McDonough:
So a couple of follow-ups based on what you told me. One of the things we are learning is that many of these AI tools are being built to please or to come up with an answer all the time, and maybe sometimes the answer may not be right, but you hopefully have this physician on the other end or a healthcare provider reviewing it and saying, "I don't know if this is right" and addressing it. When you're talking about something in a robotic world, it's going in there and it's suturing or it's doing things. How do you account for if it makes a mistake or if those types of things happen? Is it possible to prevent those things? I'm sure that's part of your work.

Dr. Yip:
Yeah, this is a really good question, and it really highlights, I think, the difference between chatbots and LLMs—basically this idea of intelligent AI being used to unravel medical context and decision-making—and then robotics, which is very much something of physical performance, right? With physical performance, we have a pretty solid understanding of physics. We have ideas of digital twinning, right? Taking preoperative scans of patients, converting that into an understanding of their anatomical layout and the stiffnesses of tissues, where they are physically in space, and we can use that information in a way that can ground what the robot's going to do. So unlike a chatbot, with a robot, it has a true awareness of geometry and of mechanics of tissue, and we can use that to make sure that if it sees that it's, let's say, retracting a tissue or trying to cut something, it is aware of, “Am I putting too much strain on the tissue? Is this vessel underlying the tissue within a region of safety that I don't want to exceed?” And at that point, you can make decisions that are grounded in physics that are explainable, and it's not hallucinating or providing answers just to please the user.

Dr. McDonough:
For many years, I served as a chair of a department with limited knowledge of accounting and money management and those things. All of us as physicians who become chairs learn the realities of medicine and that things cost a lot of money. So when I hear robots could really help fill gaps and do things, I also look at it and go, "Wow, it's hard to get a da Vinci robot," let alone something you might be creating. Where does the finance and the money come in? Could this actually widen a gap from those hospitals or institutions that have versus those who don't have it?

Dr. Yip:
This is, again, a really interesting moment in time that we have right now, because if we again take the da Vinci as an example, despite them being the large monopoly player in the field of surgical robots, how many of the da Vinci robots are actually out there in the world? How many have they produced over the last two decades? We're talking in the tens of thousands, and at that scale, you cannot manufacture something at that scale without it being expensive, right? You really have to look at the cost of building systems, getting into the millions of units, before the costs drive down dramatically. That's why these robots, even with a system like the da Vinci that's the most widely used robot out there, haven't been effective at coming down, most of them, below a million dollars—the da Vincis and these large, multi-tower systems routinely now are several millions of dollars, right? So there's this class of robots that are designed for particular procedures like laparoscopy, that will only serve that type of procedure, and therefore, will only be manufactured so many times. Then you take something like a ubiquitous robot, like a humanoid robot, that could be used in any kind of scenario, and if you keep manufacturing that at scale, the costs drive down dramatically. And so we're seeing humanoid robots being sold, many of them developed in China, at scales that are even less than $10,000, right? And so now you have an ability to see this type of technology in not only metropolitan hospitals, but ASCs, clinics, and remote areas, rather than these large, multimillion-dollar systems.

Dr. McDonough:
So you're building these and growing them and figuring them out and doing all sorts of things. Like you said, some may look like humans, others may just do certain functions. But when you're training them, I'm really curious,
how do you teach them? Do you have surgeons come in and show the robot what to do? Are you giving them templates? Are you letting them watch videos? How are you training them?

Dr. Yip:
Yeah, so this is basically all of the above. I think right now the way to look at robot learning from an outsider's view, or to give some insight into robot learning from an outsider's view, is that generally speaking, I don't think anybody has a solution that's a one size fits all to how you teach a robot to do a certain skill. And we very much in my lab like this idea of demonstrations because learning from a few demonstrations is really the most that you can ever expect a surgeon, for example. They have other things that they have to do. They're already overworked, so we can't ask them to sit down and demonstrate or label things for hours and hours. So it's like, “Show us how to

throw a suture a few times, and then we'll see what we can do with that." So that's what we look for on the demonstration side of things. We can always leverage videos that we find online of the same procedure or operation and their skills being performed. But those videos are out there in the wild. We never control for what tools they use. We don't have any control of the camera system that they're using. All these factors end up muddying the learning capabilities of the robot.

And then finally, the third approach that is very popular is to basically video gamify everything. And so you create a simulation of a surgical scene. You put a robot in the simulation. You put a patient's digital twin in the simulation, and you just run the game millions and millions of times and let the robot play around until it figures out the way to achieve the high score. And in that task, we actually ask surgeons to come and give scoring mechanisms for this simulated environment so that the robot learns how to achieve the task. And sometimes it's very entertaining because sometimes we get the scoring mechanism wrong, and then the robot decides to perform a task in a very unique way.

Dr. McDonough:
You just destroyed one of my best questions, because I was going to look like a genius and ask, "Do you have robots training other robots? That's a great idea." Then you just said, "We're doing video games with them," which is such a wonderful concept. Because I think anybody who's ever played a video game knows how when you get in there, you're figuring it out, and it's a great way to learn.

Dr. Yip:
It's a very safe way to learn too, right? And so I think it's also going to really push forward the importance and emergence of surgical simulation, right? We've seen this in the last decade of folks like Surgical Science or other companies providing simulation-based training. And more and more, I think that simulation-based training is not necessarily only going to be for doctors in training. It's actually going to be for robots to be used for autonomous procedures, and they're going to do it through those simulators in a gamified process.

Dr. McDonough:
I remember seeing many years ago, I actually saw a video where Carl Sagan was talking about Star Wars when it first came out and how pompous it was that all of the people who were fighting across the galaxy tended to look like us, especially the ones who were the smartest and the brightest. They looked like humanoid characters. And it was kind of funny when he brought that up because it was so true. He would say the odds are so slim. Why do we have to have humanoid-looking robots? Couldn't we just have functional robots, or is that part of marketing, believability, or comfort? Why are we going in that direction?

Dr. Yip:
I think a big part of this is marketing. There is a visceral connection, for better or worse, to a human-like form factor. Just as an interesting aside, there's this idea called the uncanny valley, and the idea is that as traditional robots, if you think about robots in an assembly line, they look nothing like us, and we have no affinity towards those robots one way or another. As robots get more and more human-like in their appearance, the more and more we could become socially accepting of them. They can look cute to us and things like that. And then there's this valley of death, which is basically where they get so close but they're not yet there, and it just looks very unnerving, and so this is the uncanny valley aspect. There's certainly this idea that, from a perspective of human interest in platforms, humanoid robots push and push us closer towards our interest and social acceptance of them, until a certain point where it becomes so close that it becomes really unnerving, and then we immediately get very distressed and find them very distasteful.

So there's that aspect, but in a practical way, humanoid robots also have, I think, a very real future, because with something like a da Vinci, where the healthcare system and the reimbursement pipelines have made it possible for a system like that to survive and thrive and be paid off, there are things that are worth automating, in my opinion, in healthcare that cannot justify a standalone robot system. For example, I don't think you can have a robot that is designed only for the purposes of doing an ultrasound. If you have a robot just to do ultrasound, and then you have a robot just to do, let's say, putting on a pressure cuff, you start building hundreds and hundreds of different robots that have to all fill the hallways of hospitals or clinics, that all have to have their own training manuals and that everybody has to be trained on. It's just not scalable. And if you took everything like that and you compressed it into a general platform that could do all of it, then you'd see the value there. So I believe humanoid robots will be the ultimate reality of many different use cases packed into one. But there's also still going to be those da Vincis out there that are going to be really good or better than humanoid robots at doing one particular thing very well, and they are worth the money.

Dr. McDonough:
I know what you're saying. I like the way you explained the value of what it costs versus maybe getting something cheaper that does a lot of things. One of the problems I had as a clinician with electronic health records was they weren't really built with a lot of physician input initially. It's happening recently, but it was mostly built to bill code. So a lot of what we did in the electronic health record wasn't intuitive. It was more like an engineer's idea. How much have you been talking to clinicians and getting their input about what a surgeon needs, what a surgeon would want, and what would make their life better? Has that been a big part of what you do? Are you doing it in a

vacuum? How's that happening?

Dr. Yip:
This is a great question too, because at UCSD, we have an incredible school of medicine and clinical team that we work with. Everything that we do, from robotics to automation to the AI side, we do it with our clinical collaborators. Of course, I also recognize that we are in a very privileged community where we have adequate resources to explore these technologies and to address a population that has good access to healthcare, and we don't normally see the challenges facing many communities that are either more remote or have less resources. That has always been a challenge, I think, for us as medical robotics researchers to understand what the broader community needs are. I think that we in my lab are trying to work towards that by being more vocal about what we're doing and talking to those who are in different communities that we don't normally speak with.

But I think this is going to be a challenge for everybody because it's difficult to address these really challenging problems, first off, when resources are tight in communities where they generally do not have straight lines of communication with engineering groups developing these technologies. I think it's going to be tough for a lot of people to make sure that we're addressing the right problems.

Dr. McDonough:
Now, I know a lot of what you're doing, obviously, is in the lab, and I also know things are happening really fast when it comes to AI and a lot of our developments. It's a rapid pace. We're just seeing change quickly. What do you see as the first tasks that you might see the robots you're working with doing? What would it be? Is it suturing? Is it handing instruments? What would you say?

Dr. Yip:
So I think the biggest value and the most near-term value right now is in assistance. So all the assistive tasks from a surgical assistant or a technician, especially in things like laparoscopic surgery, where there are established platforms and the automation comes through software and doesn't require re-engineering in a full system—that's where we're going to see the first rollouts of autonomy. So things like surgical retraction to clear the surgical field, things like autonomous blood suction, and all these assistive tasks that you might normally need a secondary assistant to perform, you might be able to do with a robot arm. Also, endoscope manipulation, right? Holding the endoscope still or following your tools and following basically what's happening in the surgical scene. All of these, I think, can be automated in the near term.

Dr. McDonough:
One big part of my career has always been medical education, and clearly, we're trying to come up with new and creative ways to educate young doctors. For young surgeons, where do you see the role of robots and robotics in teaching future surgeons? Will that be a part of how they're designed?

Dr. Yip:
Yeah. I think that it's going to be interesting whether they're going to be used in that case. I think that there's still always going to be the primary need for a human to teach another human how to do tasks, but you can always supplement it with educational technologies like simulators. And if you go from a software simulator, of which many of these surgical robot companies have created their own simulation platforms to train surgeons how to use their platforms in a simulated environment, but then you extend it to more physical scenarios, with a robot, teaching side-by-side, I can see that, being a possibility. But I do think that there's going to be a very strong primary role of human-to-human teaching still.

Dr. McDonough:
Interesting. I like the way you're approaching it. Now, I want to ask you some of the toughest questions because you do have unique insight. We're talking a little about where surgical robotics is headed, but what worries you? Where do you have concerns? What keeps you up at night thinking about things?

Dr. Yip:
One of the things that concerns me about where we're headed, from the engineering side approaching surgical automation and robotics, is that I think there is limited awareness of how the approach in which we do and implement robot automation needs to change with the field that we're actually applying it to. So we see a ton of technologies developed today, many actually from these AI companies. They have robot labs today, and they are in this process of saying, "Pull all this data in, throw it into a giant black box, and it's going to spit out an answer." And there is an increasing lack of awareness that you can't really just do that for a field like surgery, where you cannot just assume you collect enough data and the black box will be the solution at the end of the day that will solve this problem. There's no idea of safety. There's no idea of truly what the robot's thinking. And so that's what worries me, that as engineers, as a field, and as roboticists, we're following robot learning techniques that are developed for a very different and less critical application case. And so I think that's one thing.

From the implementation side, one of the things that I think we have to be really careful about is to not overstep, right? So we want to look at it from even the idea of autonomous driving as a good example of how we can say that we're heading towards a direction of full autonomy to meet the needs of society, but we have to roll it out very carefully so we maintain a level of trust with the public. If we overstep that by being too cavalier with how we roll out technologies like this, it's very hard to regain that trust with the public. And of course, this is something that obviously the medical community understands, this idea of patient-provider trust, but it's something that surgical roboticists really have to also grasp as well.

Dr. McDonough:
That's an excellent point. One of the things in hosting *The Convergence* that I've learned by asking that question is there's a lot of these things that are tricky and get buried under the excitement that we need to talk about. Another example, for instance, with learning and some of these models, is they might come up with a great diagnosis you believe. But then if it's built to please, maybe in the toughest case, that might be where the wrong answer comes or when you start trusting it too much and the pressures of seeing patients and increasing volume and all those things happen. Where will those errors occur? Just like they occur with human beings? So I think what you're bringing up is a really good point, like how we manage this and release it. I'm sure a lot of people like the science fiction approach, and they want this and they want that or they're scared to death of it or whatever, but there needs to be so much education as part of this.

Dr. Yip:
That's especially true, yes. To be able to not only teach people how to use these tools and how to question if those tools are accurate in what they're doing, that's definitely one side of it. And then from an engineering side of it, developing the models, those tools wherein baked into how they operate and baked into how they perform autonomy, they are aware of their limitations, and they are not going to provide behaviors that they know they're uncertain about or they are unsafe about.

And to call back to something I'd mentioned before, when we're talking about robots that physically interact in the real world, we can bake into the robot's understanding physical geometry, physics, the idea of interaction with tissues, patient, preoperative scanning, and things like that, which can be used to evaluate safety and uncertainty.

Dr. McDonough:
Michael, I've asked you a lot of questions. Is there something you wanted to bring up that I didn't ask you? Like, “Oh boy, we surely should have talked about this”?

Dr. Yip:
I think that one of the things really worth discussing sooner than later is this idea of regulation. How do we regulate the deployment of robotics from not only ideas of how does a doctor that's in California operate on somebody, in New York, right? What needs to happen there to realize that in the future? There’s obvious benefits to having experts from one location provide care to others in a different location, and the technology's there. It's been there for a decade or two. But I think working out the logistics, and really more the rules and the licensing of the doctors, like who's responsible in what scenarios, I think, would be something really worth discussing. And of course, how do doctors look at this idea of robot-human teaming, again, from this perspective of training and then responsibility and so on and so forth?

I think for the tech barriers right now, some of this is technology barriers, but if we're just talking about remote control of a robot, that's not a technological barrier. So what is that barrier today? It’s going to be education, it's going to be training, it's going to be licensing, and it's going to be the hospital system trying to figure out how to place this technology. There are going to be benefits for the patient if this works, but there's a lot out there that has to be solved before you can really deploy it comfortably. I think there's a lot of unknowns still that are not technology-based that need to be understood.

Dr. McDonough:
Thank you so much. I really appreciate this conversation. I think we all learned a lot, and it is fascinating work, and keep up the great work. It's really exciting what you're doing.

Dr. Yip:
Great. Thanks. It was very nice to talk to you.

Dr. McDonough:
For ReachMD, I’m Dr. Brian McDonough. To access this and other episodes in our series, visit *The Convergence* on ReachMD.com, where you can Be Part of the Knowledge. Thanks for listening.