

## **ESTI NEL PRESENTING ON RESEARCH AT COCHLEAR LTD**

**ESTI:** It's absolutely my delight to be here this morning with you. Thank you so much for the invitation from the CICADA group.

I know there are also some other colleagues of mine from Cochlear here. Do you want to get up and come to the front - Christina, Joanna and Jim? Why don't you quickly introduce yourself and say what your role is at Cochlear?

**CHRISTINA:** My name is Christina, and I am the Community Engagement Manager at Cochlear. I oversee the volunteer recipients at Cochlear if volunteers want to share their story to assist candidates in their hearing journey and whilst doing that raise awareness about hearing loss in Australia and New Zealand as well. I joined Cochlear on 27 February of this year so I'm still a baby.

**JOANNA:** My name is Joanna and I am a colleague concierge. My role is to help candidates who are interested in cochlear implants but may not know where to go, who to see, what to do next and who may have some questions about is it right for them. I help them go through that pathway and connect those people with volunteers and recipients like yourselves and support groups to help them along their hearing journey.

**JIM:** Hello everyone, my name is Jim and I have been at Cochlear for four weeks. This is all very new to me. My role is to be Program Manager for Rehabilitation and Outcomes. This is a new role. We are interested in finding new ways to help people who have a cochlear implant adapt and find new ways of getting on. I am really interested in speaking to anyone who has great ideas, thoughts or suggestions to make us better at building great tools, building things that facilitate community and facilitate learning to help people get on and get the best outcome they can.

**ESTI:** Thank you so much. Make sure that you talk to them over the barbecue period.

## **Research**

**ESTI:** Hi everyone, my name is Esti Nel. I can see a lot of familiar faces in the room. It's so lovely to be here on this wonderful Sunday morning. Katie sends her apologies. I am afraid you are stuck with me for the two presentations. The triple treat has changed to double delight.

The beautiful building that you can see there is actually the Cochlear headquarters at Macquarie University. If you haven't been there yet, then I really urge you to go for a visit. We offer wonderful tours. It's really an interesting place to be. I have been lucky enough to work with Cochlear for the past 17 years.

I have to start a presentation with Cochlear's mission. At Cochlear, even in any internal presentation we do, we start with our mission. It really reminds all of us why we get out of bed in the morning to actually go to work. I really love this mission.

We help people hear and be heard. We empower people to connect with others and live a full life. We transform the way people understand and treat hearing loss. A group like yourselves do such a lot of good work in this area. Then we innovate and bring to market a range of implantable hearing solutions that deliver a lifetime of hearing outcomes. I am specifically going to talk about the innovation bit.

My goodness we have come such a long way. Many of you here will know this picture taken in 1983 with the world's first commercial multichannel cochlear implant. Has everybody seen this photo?

This next slide shows something that makes me so proud to have been part of this cochlear implant journey from the very beginning. This is the range of our sound processors from 1983 until today. I first became involved in the world of cochlear implants in 1989 when back in my homeland of South Africa we started a cochlear implant program in Pretoria. It was very new; it was wonderful; and it was sort of scary technology. It was kind of thought of as experimental. We were so amazed as audiologists when profoundly deaf people could hear an environmental sound like a dog barking.

Move on to today and the world is our oyster. We listen to all kinds of sounds; we listen to music; we speak on the phone. Technology has come so far.

I started at Cochlear in the year 2000 when I came here just after the Olympics. I first worked as a clinical specialist in the Australia-New Zealand team. While I really loved that field work, when the opportunity came to work in the research and design team to be part of the design and development of new products in about 2003, I thought this sounds like a job for me.

I remember that the first clinical study that I ran at Cochlear in that role was around 2003 when we tested the Esprit 3G for Nucleus 22 recipients. Since then we have gone Freedom; we have N5; we have gone N6; we have gone Kanso; and this year we have just launched another new sound processor in America and Europe.

What are the different types of research at Cochlear? It's such a broad topic actually. In the design and development team we do a lot of work to make sure that a product is safe and effective to use on a human before we can give it to a real recipient. Bench testing happens where a lot of experiments can happen on a bench physically without a real head connected to it. It's an experiment and can prove a whole lot of things.

Basic research studies can happen. That's mostly in our Melbourne and Denver offices where it's very early research, sometimes even animal studies that take place.

Then we come to clinical studies, usability studies, focus groups, market surveys - But what is the journey from an idea to a product? We have become a highly regulated industry. The cochlear implant is a class 3 medical device and as such we have very stringent rules and regulations and processes that we have to go through, which is a good thing. So really this journey can take many, many years.

Think of a new implant. First of all, we need to understand the needs of the customer or the recipient, we understand also some of the technologies that may be available to us. For example, things like bluetooth in today's day and age helps us to make something which doesn't have a wire so it's all wireless. We then come to an initial solution idea, and many years pass before that concept is a little bit more mature. It's not weeks or months, it's really years.

Then we go to the product development cycle if we are going ahead to make a commercial product. The product development cycle in itself can take years consisting of many different milestones which we have to pass through. It's not a case where we

can just say, 'I have an idea of something new, let's make it and get it out there.' It's much more complicated.

A typical product development study is the part where my team work in terms of supporting the engineers in the new product development studies. We typically test new sound processors, new accessories, new software or new algorithms, which mean it could be a new program you want to use, say a program that helps you to hear better in wind or a program that helps you to hear better in noise.

It can be a take-home study or an acute study. For one it means I can give you some things and you take it home, use it at home in your own environment and then come back and tell me about it. Acute means I only need to test you in the clinic at Cochlear for an hour or so and you don't get to take it home. There are different reasons why we would do acute versus take-home.

Many of you here in the audience know that the studies often involve speech testing, perception testing in a sound booth. Some of you have different names for that activity because it often takes a long time with a lot of different words and different sentences in noise that you have to repeat. But the main way for us to judge whether an implant processor is delivering the correct outcome is to actually test it by measuring what you are actually hearing when you hear speech. You have to repeat back what you've heard.

It very often involves completion of questionnaires. Questionnaires can have open fields as well as ratings like 'how satisfied are you with the new processor, how comfortable was the new ear hook,' things like that.

We can't do just one or the other. Speech perception testing is very important and in the laboratory that is a good outcome, but what we really want to know as well is how well do you hear at home and in your real world, in your real life, how does it actually work for you?

Finally, usability studies - these have become more important over time. As I said, we are a class 3 medical device company. Have you ever bought something at JB Hi-Fi, you bring it home, open instructions and try to put it together but you can't understand a word of those instructions? We want to ensure that our instructions are easy to understand for our recipients. So we bring people in and let them read through the instructions and do certain tasks to prove that these instructions are good.

Of course, participation in any research at Cochlear is always voluntary. We comply with all of the good clinical practice rules about clinical studies. We also have ethics approvals for studies that require it.

Just some examples, this is a typical graph that you may see when we talk about speech performance data that is being collected. We will test, say, 20 subjects in the same way with the same programs and compare the same things in each subject. Then we will come up with a graph like this showing a benefit of one processor over another. While this is important, what is also very important is, as I said, the questionnaires, the subjective data. While in the lab, you scored 80 per cent but, when you went home and it was very noisy, perhaps you couldn't hear very well. It's a story that complements each other. These are just examples of questionnaires that people have completed and where we can rate their satisfaction, for example.

You can also see we have anecdotal comments from subjects. It is very important to keep all data non-identifiable, so that the research subjects' privacy are respected.

These are some photos of usability testing that we have done. Actually this is with a clinician. Just as we want to test recipients like yourselves, we also want to test clinicians. We give them the instructions there on the side and without any help from us they then have to perform some tasks. This one here is showing how they connected the programming cable to the Kanso and also in the right-hand corner is how they were able to fit the aqua onto the Kanso processor. We take it all very seriously.

We work mainly with adults at Cochlear in our lab there. But we know that children are different with different sized ears, heads and minds. Everything they do can be different. Sometimes we contact SCIC or other clinics and say, 'Can we go to one of your facilities and meet up with some parents with young children with cochlear implants and can we fit them with a new ear hook or in this case a new retention mechanism?' You can see the little plastic tubing around the girl's ear keeping the processor on. In this case it may be that the processor isn't even a functioning one with no sound going through. It's brand new, a prototype, but we can check how well it fits.

Other times we do more interesting things. We sometimes get people to play table tennis at Cochlear to see whether devices stay on heads while playing table tennis. Other times we ask them to walk outside in the car park and walk away from us so that we can check to see, for example, when using a remote control how far does the range go. Many different things.

I want to end – almost end - this part of the talk by saying the future is so very bright for us. If we go back a little bit to 1973 - some of you have not been born - the first mobile phone call was made on 3 April 1973 and at the time the device offered a mere 30 minutes of talk time per 10-hour battery charge. We must have thought nobody is ever going to latch onto that. This was groundbreaking technology.

No-one could have predicted that by 2014 mobile devices would outnumber people on the planet. We have come a really long way. Taking it one step further for us today, who could have predicted that in 2017 calls would be routinely taken on mobile devices by people with profound hearing loss? It's really such a wonderful time to be involved in all of this technology.

Part of the reason I am here today is to tell you what we do but also to find out whether any of you are interested in taking part in research at Cochlear. Many of you already do. You may spot some familiar faces in some of the photos. They show milestones. Sometimes when we have a brand new product and we test it with someone for the first time, we get a group of engineers who have worked on the product together and we take a photo to celebrate. We really want to mark that as a milestone. Here you can see many different people, many of them engineers at cochlear.

I can't stress enough how much it means to any of these engineers to meet a cochlear implant recipient, to talk to them, to find out what their life is like living with their

device. It makes them so motivated to get up and come to work the next day and do amazing things.

What is required from a research volunteer? Well you need to have time to attend visits at Cochlear. Typically the visits can be about one to two hours. Sometimes they are fortnightly; sometimes they can be weekly. Sometimes it's just one, at other times it can be 20, depending on the study. You need to live in Sydney or surrounds. You need to be willing to travel to us. We do compensate for travel for the study.

You need to be able to provide clear feedback on your experience with it. I know it's very difficult at times to say in words what it is that you're actually experiencing - Is the sound echoey? Is it hollow? Is it soft or loud? It's very difficult. We appreciate all feedback. Typically you need a stable map from your clinician. At our studies if we test products we don't typically do routine mapping. You come with your current map and your own clinic remains responsible for the maintenance of your cochlear implant.

Today at the barbecue we will have a sign-up sheet if you want to leave your name and contact number then we will really appreciate that. This is the end of the first part of the talk. What I thought to do was to continue on to the second one and then have questions.

## Kanso Processor

**ESTI:** This talk was from my lovely colleague Katie Neal in the Australia office. I know she often visits the Sydney Cochlear Implant Centre as well. We spoke about our mission of innovation but we also have a part in our mission that says 'We want to bring the technology to the masses'. We know how absolutely under-penetrating cochlear implants are. There are so many people that could benefit from a cochlear implant but they have never heard of it or they don't have one for some or other reason. It could be that they are scared of surgery. It could be they really just don't like the technology. They don't want to wear something behind their ear. It could just be not enough information.

Kanso, as our first off-the ear sound processor, in a way helps a little bit with attracting perhaps a group of people that did not feel they wanted a behind the ear sound processor. They will be quite happy to wear something a bit more discreet under their hair and something off the ear. There may be candidates like that.

Kanso is really based on Nucleus 6. It's the same technology. The wonderful thing for me in the way the engineers built that was that you didn't need to worry about doing any fancy mapping or anything like that. They made it so the microphones when you have it on the side of your head will sound exactly the same as the microphones when you have it behind the ear. That is why we put in the dual microphones and have the smartsound, have it splash proof. You can use wireless accessories with it. Also you can use remote assistant.

Coming back to Kanso, we have talked about how the off-the-ear processor is similar to the behind-the-ear sound processor because it has the same smarts built in. Something that our engineers took a long time to develop was the smart sound IQ with

SCAN. That's really another name for an automatic scene classifier that listens to the environment and can detect which environment you are in. It can actually do the correct thing with your program so that you don't have to change the program all the time. With Kanso we have exactly that technology. You can put it on and forget about it.

The importance of having two microphones over one microphone cannot be stressed enough. This is something that Cochlear has had for a very long time in our technology. We are able to program those two microphones together so that they can do many different things like cancel out noise from the back, be clever about the environment that you are in. Dual microphones are very important.

Here is one of the graphs that we talked about before in terms of speech performance. It shows how the bars go up and how much better you can actually hear when you have dual microphones over a single microphone but also when you use your SCAN program that does everything automatically for you. The performance in noise we found with Kanso was really good. We wanted to make sure that Kanso also delivered the same as Nucleus 6. We tested people with behind the ear and off the ear in the same session and we found no difference between those two.

Kanso is a really simple and easy to use processor. If you have a person in mind who finds it too much to have different parts like the main module, the cable, the coil, this has only one part, where once you put it on you can't go very wrong.

What it looks like on the inside is giving you all the same things as behind the ear. You can change the program with one button, microphone protectors you have to change, there's a magnet and there are two zinc ear batteries. That's the way the Kanso works. You also have a light to show you what's going on. If you take the processor off and you're unsure what's going on, it will be blue when you use one of the wireless accessories, green when you listen with a microphone, and orange always means it needs attention, something is not good.

You have the CR230 remote. This will help you if you don't want to press the button on the processor then you can have the remote in your hand and press to change programs.

These are some of the comments, and this was actually from a study that we ran in our in-house lab as I talked about before. One aspect that kind of blew us away and that we didn't expect was people saying that suddenly their confidence has improved because they felt they had a more discreet hearing solution. They really liked using that and gained self-esteem. One lady came in and said, 'I like wearing dangle earrings again,' as sometimes with wearing a behind the ear processor you don't want to wear the dangles. The Kanso is very comfortable to wear.

Also we have an aqua plus for the Kanso. You can pop it into the cover and you can actually swim with it. We have many different things that will keep the Kanso on your head. That's a concern that people have when they first start using it. The most popular solutions are actually these little clips, the same clips you use for hair extensions. They are really good.

What about in the real world? We are very proud of this wireless technology which took a lot of time to work on with the GNResound people. You don't need any cables to plug in, you can still watch TV with TV streamer and use mini mikes.

In summary, Kanso is the lightest and smallest off-the ear sound processor. It has eight colours. You can choose it with your hair colour. It's got more colours than the behind the ear. We felt it needs to blend in with your hair.

It works with disposable batteries. If you wear an acoustic component like a hybrid implant and are also using that for low frequency hearing, you can't use a Kanso. Kanso doesn't support the acoustic component. It doesn't work for Nucleus 22 implants.

Are there any questions?

**QUESTION:** *With the Kanso you use disposable batteries and you don't recharge them as you do with the behind the ear?*

**ESTI:** Correct, you can't use rechargeable batteries with the Kanso. Kanso requires 2 disposable zinc air batteries (675 size).

**QUESTION:** *What is the length of time those disposable batteries last?*

**ESTI:** How long do the batteries last? Battery life depends on a whole number of features. It depends on the thickness of your skin, your map, how big is your dynamic range - many different things determine every individual's battery life. We found in the Kanso study that the zinc airs for the majority lasted quite a long time. On the whole they were very satisfied with battery life. I can't give you a number. I need to look at your particular map.

**QUESTION:** *I was going to ask the same question about how long the batteries last for. My disposable batteries last for three days.*

**ESTI:** It would be similar, anything from one day to three days but it depends on your map.

**QUESTION:** *I may have missed this: with the Kanso can you use it with the cochlear and a hearing aid?*

**ESTI:** With the Kanso can you use it with the Kanso on one side and a hearing aid on the other side? Yes definitely. It may have been confusing when I said if you have a cochlear implant with an acoustic, that is, a hearing aid on the same side as the cochlear implant you can't do that with Kanso, but you can have the hearing aid on the other ear.

**QUESTION:** *Going back to the research, I have a research background so I'm interested. Of course it takes years to get from the idea to the final product. You've just announced Nucleus 7 or something in America, an apple product. Does that mean that the nucleus 10 or 11 is already being tested at a bench scale now?*

**ESTI:** Neville asked a very good question. If there were a bunch of engineers in the room they would be clapping their hands for you. Yes, there are different groups at Cochlear. There are the groups that look at early research and look at the product development plan and the future. At any time we have at least a five-year plan of

where we are because it takes years. We are already working on future generations of things.

It's a very interesting time at Cochlear because back 10-15 years ago we had one product we were working on. Now we have many different ones in parallel and many different teams. So the challenge remains how to do it all with the manpower and the resources that we have available. You're spot on. We've worked with Apple, for example, for the past five years. It wasn't just a phone call a few months ago, no, it's a lot of work.

**QUESTION:** *One question I would like to ask: I understand that Kanso and Nucleus 6 are the same. But what about the old models, would that fit?*

**ESTI:** Which model of implants does the Kanso work with? It works with anything from the N24 implants. It only doesn't work with the N22 implants.

**QUESTION:** *The Bionic eye, are you working with anything because I know what I heard last time they are trying to work out where to put the connector. When people have an EYE implant, where they are going to put it? Are you working with anything like that?*

**ESTI:** The question is about the bionic eye and whether we are working in conjunction with bionic eye and bionic ear. The bionic eye work is in Melbourne. As I mentioned, our basic research office is also in Melbourne in the hearing precinct there at the University of Melbourne. Of course Professor Graeme Clark is there and Peter Seligman, one of our well-known engineers, is there. I know that Cochlear engineers advised on the bionic eye project about the technology. They are using a similar electrode in the bionic eye. I don't know what the collaboration is like at the moment. I can imagine that is something we will be very interested in and keep a close watch of.

**COMMENT:** I have actually been doing research with Cochlear for the last 12 years and working alongside Esti and her wonderful team. From a recipient's point of view I want to say that having the opportunity to work with the research people to see and help develop new technology, to tell them what's good and what's bad, to watch it evolve around the new technology to what it is today has been absolutely wonderful. To work with such dedicated professionals and amazing engineers at Cochlear has been an absolute mind-blowing experience. If anybody here today does have some free time and is interested in joining the research people - I know there's a few people here that do the research with Cochlear - I would thoroughly recommend it if you have the time to spare.

They are the most dedicated people. They always make you feel welcome. Nothing is any problem. The testing can be a problem. You do get hours and hours of sentences and words and things. They put us through our paces. But without real recipients to do that testing, then they wouldn't be progressing at the level they are today. I do recommend it to anyone that wants to do it. I have been doing it for 12 years. I hope I can do it for many more years to come.

**ESTI:** Thank you.