Podcast 4. Mel Lough. 'Data logging: A measure of use, or a useless measure?'

Gaby: Hello and welcome to this next ManCAD - British Academy of Audiology podcast.

If you have listened to any of our prior podcasts you will know by now that ManCAD stands for 'Manchester Centre for Audiology and Deafness' and that we are located at the University of Manchester in the UK.

I am Gabrielle (Gaby) Saunders. I'm a Senior Research Fellow at ManCAD and I moderate these podcasts.

To date we have focused on topics pertinent to the practise of audiology and to people with hearing loss during COVID-19, but we will be continuing these podcasts on into the future, and so will address a broader range of topic areas - but always ones that are on the forefront of audiology.

We will record a new podcast each month and will post the audio recording along with a transcript on our University of Manchester webpages.

Each one will be about 20 minutes long. You can find information on the front page of the ManCAD website. The URL for that is: http://research.bmh.manchester.ac.uk/ManCAD/Podcast/

Our speaker today is Melanie Lough - a Research Audiologist at ManCAD.

She is going to be answering a few questions posed by me on the topic of 'Data logging: A measure of use, or a useless measure?'

Before I begin – I am going to hand you over to Mel who will tell us a bit about herself.

Mel: Hi Gaby. Thank you for having me on your podcast series. I'm a clinical audiologist by background. I got my MSc in Audiology from the University of Manchester whilst working at Salford Foundation Trust where I stayed for about 14 years. My clinical work was largely split between adult rehab and vestibular assessment and rehab. In 2018, I returned to the University to be a Research Audiologist, which is where I am today.

Gaby: Thanks Mel. So where does your interest in data logging come from?

Mel: I'm now into my second term of being a BAA Service Quality Committee member. In one of our meetings, another committee member raised a story of a patient who had not been informed of having data logging on her hearing aids. It only came to her attention when there was a discrepancy between her self-report of hours of use and data logged hours of use, and she was made to feel like a fraud in her appointment; this led her to not attending her audiology department for 2 years. Off the back of this, I wrote an article about the ethical and legal issues of data logging for the BAA Magazine, and as a committee we have begun a systematic review of the literature in order to produce some guidance or knowledge summary for audiologists on this topic.

Gaby: That sounds useful. Do you have any idea of when it will be available?

Mel: The initial timeline for the document was for completion towards the end of this year, although unfortunately this is delayed due to the pandemic. I would hope the review, at least will be done by the end of October.

Gaby: Can you share any key findings with us now?

Mel: It's still in the quite early stages; the literature searches have been completed and we've almost finished reviewing the papers for suitability for inclusion, which includes papers that cover either:

- Reliability of data logging
- Potential benefits
- Potential disadvantages/limitations
- Ethics and personal impact of data logging
- Data privacy in relation to data logging

Gaby: I guess we are going to get a preview of some of that today from you?

Going back to the case you mentioned earlier, I know it is common for studies to show discrepancies between HA logged data and self-reported data. What do you think is going on? Is it a HA-problem or a patient reporting problem?

Mel: There can be many reasons why a discrepancy occurs. I think patient factors are the ones that most of us audiologists will think of first. Like, the patient either not recalling correctly or wanting to give a more positive estimate in order to please the audiologist, or the patient not fully understanding how to use the hearing aid and either leaving it constantly switched on even when not worn, or wearing it but not turning it on.

I would just like to say at this point that it is completely natural for someone to want to convey a more optimistic impression to his or her health care professional. How many of us tell our dentists, “yes, I floss every day”, but the truth is probably slightly less than that. So I don’t ever believe that berating a patient or making them feel bad in this situation is ever going to be helpful. Actually, this situation is easily prevented by educating your patients about data logging at the fitting stage and asking for their consent to its activation. There is a relatively old study by Taubman et al. that compared a group of participants who were informed about data being logged prior to the study with a group who weren’t told. The group that were told gave significantly more accurate self-reports of their hearing aid use.

As well as patient factors, there are also hearing aid factors, which I don’t always think are given the attention they deserve. These include the algorithm used by a particular hearing aid and how accurate or reliable the data logging feature is. For both of these, it’s a matter of education. If you have a more detailed understanding of them, you will be better able to make sense of any discrepancies that you come across in clinic.

Gaby: So just curious with the Taubman study, the subjects were in a research study not clinical patients weren’t they? So they could in their heads think they are measuring this so I should make an effort.

Can you tell me more about data logging algorithms in hearing aids?

Mel: Algorithms will vary between hearing aids and the details are not typically made explicit in the information provided by the manufacturers, so it’s something that audiologists would need to proactively research or test themselves. By way of an example, I tested some premium hearing aids before lockdown, and in terms of hours of use, they only logged 1 hour, when they were switched on for a complete hour. If they were switched off at 59 minutes, and then switched on for another 59 minutes before switching off again, the data logging would still show zero hours of use. I think it’s very easy to see from this how it could lead to discrepancies in clinic. If you think about younger children who nap regularly during the day, it’s not surprising that parental report might appear to “over-estimate” hearing aid use. It’s also potentially why a study much cited study by Laplante-Lévesque et al. (in their 2014 study) found that participants were less accurate in their estimations of use when they had an on/off pattern of hearing aid wear. If you think about a patient who puts their hearing aids in on 4 separate occasions during one day for, say, an hour and 45 minutes; you’re already looking at a 3 hour discrepancy.

Gaby: Just because the second hour and 45 minutes never registers.

Mel: Yes, that's all down to just how the HA algorithm works.

It's not just the amount of time. The manner in which the average use is calculated will also vary depending on the hearing aid algorithm. It's not always clear if the average is taken over the previous 1 or 2 weeks, or over the entire data collecting period since the hearing aid was fitted.

In terms of the research you mentioned earlier that has directly compared data logging with self-report, I'm not sure whether these algorithms are always given enough regard. There are exceptions to this, but often participants in these studies are not asked, "over the past x number of weeks, how many complete hours, on average, have you worn your hearing aids per day?" Of course, this sounds a bit long-winded, but when you just ask "how many hours do you wear your hearing aid?" you are not necessarily comparing like for like. The same applies to when you're comparing a patient's report and data logging in a clinic appointment. You've got to allow for the fact that there might be a difference simply because of the particular algorithms in the hearing aid and the way you asked the question.

Gaby: Would be really helpful if we had more information about that up front. So far you have just discussed hours of use, there are many other features. Data logging isn't just about recording hours of use, though, is it? Tell me about some of the other available features.

Mel: The other main data logging features that are audiologist-facing in hearing aid fitting software are:

- The proportion of time a hearing aid is in a particular programme, or an accessory is used.
- The proportion of time a hearing aid detects particular auditory environments, such as speech-in-quiet or speech-in-noise, or the time it has switched to different modes if in an automatic setting.
- Average volume control position.
- Not mentioned up to now. Data logging in cochlear implant processors also goes further in that you are often given coil off and on times, which means you can verify that when the processor is switched on, it is actually being worn.

There are also potentially other aspects that will be logged (or can be inferred from that information that is visible) but that aren't always obvious from the clinician's screen, such as signal to noise ratios, sound levels or the directional mic settings. Not always obvious in the fitting software.

Gaby: We did some work where we had all these bits of information and how can it be used and I assume you're going to talk a little bit about that.

I know the study we did, some of these features audiologists really like e.g. how much time spent in speech in noise because they think they can use that to potentially upgrade a patient onto a more sophisticated hearing aid. It would be interesting to know how all of those different variables are used.

You said something before about the accuracy of data logging. What do you mean by that? Do you mean the HA has errors in what it's logging or the HA is misinterpreting what it 'hears' how it classifies things?

Mel: A bit of both really. In terms of hearing aid use time, I think it is probably safe to assume that the internal clock within the hearing aid will be accurate and reliable, although this isn't easy to evaluate from a clinical perspective. As I mentioned earlier, another common feature of data logging is the percentage of time that the hearing aid is believed to be in a particular mode, for example, to optimise listening for speech-in-noise or music. The value of this feature will obviously depend on how accurately the hearing aid classifies different listening environments in the first place. In other words, there's a distinction to be made between this feature of data logging being able to accurately log

which setting the hearing aid has been in, and it being able to accurately tell us what sort of listening environments the patient has been in.

There is a study from Germany in 2017 that looked at both of these aspects. They first tried to measure how well two different hearing aids were able to classify a variety of test signals into speech, speech-in-noise, music, or noise. Overall, both hearing aids were accurate, although there were some anomalies, like piano playing being confused with speech, and there appeared to be some occasions where the authors suggest that the hearing aid was possibly switching between classifications on a short-term basis. They only compared the data logging from one of the hearing aids with their real time measurements, and there was good agreement. However the algorithm used by the hearing aid will have some bearing as classifications are only logged after a set amount of time, say 30 or 60 minutes. I guess in summary, data logging, in terms of scene analysis, is accurate in as much as it can detect what setting the hearing aid is in if it's predominantly in a particular programme for a set amount of time. It may be less accurate for logging more transient changes, and may not always be representative of the listening environments that the patient has actually been in.

Gaby: The information is a guide not a be-all and end-all.

Mel: It's pretty good. I think it's just knowing the limits of the algorithm that gives you the knowledge to make use of that in clinic.

Gaby: So far you have focused on what might be problematic with data logging. I know it is not all bad. Can you tell me about some of its potential benefits?

Mel: Now I haven't ever worked in a CI centre, so admittedly I don't have practical experience of CI data logs, but from the research, there seems to some very tangible benefits of data logging with cochlear implants. For example, data logged hours of use has been shown to predict receptive language scores in children and increased data logged hours of use is associated with better performance on speech tests in post-lingually deafened adults. To give a specific example, there was a paper published this year that showed that an average daily use of more than 10 hours (as measured using data logging) is strongly and significantly associated with above average speech recognition (potentially more than other factors, like duration of deafness or age at implantation). So in this respect, the purpose and value of data logging could easily be explained to the patient and they could be given a definite target to aim for.

For young children who spend some of their time in childcare or education, and those people unable to self-report, data logging obviously tells you more than what you can glean from either the parents or the patient themselves.

For adults who are able to self-report, there are obviously the potential benefits of picking up when they might not be using their hearing aid correctly or when an additional program or accessory might be helpful. However, the jury is out on whether a specified amount of use (as measured by data logging) significantly affects outcomes. Piers Dawes and Kevin Munro from Manchester suggest that you are more likely to see an improvement in SiN scores over the first 30 days of being fitted with hearing aids if you have a data logged average daily use of more than 6 hours, when compared to a control group. I should point out, the main purpose of this paper was looking at acclimatization to HA, not data logging specifically. That statistic was demonstrated with a sub-group of 10 participants with moderate hearing loss only. It is not known whether 7 or 8 hours compared to more, might give you even more benefit. I think Laplante-Levesque makes a good point in one of her papers, that there's no consensus on what constitutes optimal HA use in adults, and that it's likely to differ from person to person. However, one of the real benefits of data logging might simply be to use it for mutual goal setting within patients rather than comparing between them.

Gaby: That makes sense from a clinical perspective where you are looking at the within the patient and not between patients which is a more research thing. Some audiologists we talked to have said they use them for goal setting.

Technology is rapidly getting more sophisticated so presumably what a HA can log and what we can do with that data is going to be changing. What are your thoughts on this?

Mel: Indeed. So up until recently, it has been the storage limitations of the HAs themselves that has dictated what and how data can be logged within a HA. Now, apps are available from all the major hearing aid manufacturers, which has the benefit of being able to store data (transferred from a hearing aid to a mobile phone via Bluetooth) and that data can be stored on a cloud instead. So, time-stamped logs could be recorded every minute as long as the hearing aid is connected to the patient's mobile. All the apps require consent from the user for the manufacturer to process their anonymised hearing aid and mobile app usage data. This has paved the way for some significant developments.

Firstly, the majority of apps allow the user to view their individual hearing aid data. From what I can gather, the hearing aid usage data that is displayed to the user via the app is still just based on what the hearing aids have recorded, which effectively means it will be subject to the data logging algorithm within the hearing aids. However, I still think this is potentially a very positive development as it could empower patients; they can approach us if they notice that there is a discrepancy!

Secondly, there's the potential for "big data" research. There have been a good number of papers already published in this area by Mellor, Michael Stone, and the team that are working on the EVOTION project. I know you have been involved with this Gaby. Literally thousands of patients' data could be analysed for trends, allowing for machine learning and the development of automated settings. This could then inform both policy and service quality improvements in a way that has previously not been possible. What I think is potentially most exciting about this, is how this could allow us to give more holistic care. I know it's something you've worked on Gaby, so you'll be able to give more detail on this, but I find it fascinating what insights you can get when you also combine data from a personal biosensor with the mobile app and hearing aid data.

Gaby: That's possibly the topic for another podcast.

So, back to the currently available information – how do you suggest audiologists should use data logging with what they have right now?

Mel: First:

- Educate yourself about the data logging algorithms in the hearing aids that you fit.
- Be transparent to your patients about what data logging is and the potential benefits, and get their consent to its activation.
- When discrepancies occur, consider equipment factors as well as patient factors. In relation to this, I'd also like to direct people to a paper that was published last year by Munoz et al. as they give a lovely example of how to counsel parents in relation to data logging findings.
- Keep your eyes peeled for future BAA Service Quality Committee publications on data logging.

Regarding the current pandemic, some departments may well have started exploring remote care with mobile apps for hearing aid fitting and follow up. In my opinion, it is important for audiologists to familiarise themselves with the app privacy notice in order to alert patients to the key points, because how many of us just click through terms and conditions without reading the specifics? And if this is something that your service has introduced during the pandemic, you might need to bear in mind that what a particular patient is happy to consent to now, might not be something that they are so comfortable with later down the line once the pandemic is over.

Gaby: Thank you. That was a wonderful introduction to data logging. If the audience have any follow up questions, feedback or share ideas for future topics please contact me. You can send me an email. Gabrielle.Saunders@manchester.ac.uk

I hope you enjoyed this discussion and are going to come back to the next podcast. Until then farewell and stay well.

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