

1 **Consumer Perspectives on Improving Hearing Aids: A Qualitative Study**

2 Nabeelah Desai<sup>1</sup>, Eldré W. Beukes<sup>2,3</sup>, Vinaya Manchaiah<sup>1,2,4,5,6</sup>, Faheema Mahomed-Asmail<sup>1,2</sup>, De Wet  
3 Swanepoel<sup>1,4</sup>

4 <sup>1</sup>Department of Speech-language Pathology and Audiology, University of Pretoria, South Africa

5 <sup>2</sup>Virtual Hearing Lab, Collaborative initiative between University of Colorado School of Medicine,  
6 Aurora, Colorado, USA, and University of Pretoria, Pretoria, South Africa

7 <sup>3</sup>Vision and Hearing Sciences Research Group, Anglia Ruskin University, Cambridge, Cambridgeshire,  
8 UK

9 <sup>4</sup>Department of Otolaryngology-Head and Neck Surgery, University of Colorado School of Medicine,  
10 Aurora, Colorado, USA

11 <sup>5</sup>UCHealth Hearing and Balance, University of Colorado Hospital, Aurora, Colorado, USA

12 <sup>6</sup>Department of Speech and Hearing, School of Allied Health Sciences, Manipal Academy of Higher  
13 Education, Manipal, India

14 **Word count:** 8548 (entire document)

15 **Conflict of interest:** Data for this study was obtained from Lexie Hearing which is founded by the hearX  
16 Group. Nabeelah Desai is employed by the hearX Group, De Wet Swanepoel is a scientific advisor and  
17 founder of the hearX Group and Vinaya Manchaiah is a scientific advisor for the hearX Group. Eldré  
18 W. Beukes and Faheema Mahomed-Asmail declare no conflicts of interest.

19 **Funding:** No funding was involved in this work.

20 **All correspondence should be addressed to:** De Wet Swanepoel, Faculty of Humanities, Department  
21 of Speech - Language Pathology and Audiology, Communication Pathology Building, University of  
22 Pretoria. Address: Lynnwood Road & Roper Street, Hatfield, Pretoria, 0002, South Africa. Email:  
23 dewet.swanepoel@up.ac.za. Phone: 012 420 2816.

24 **ABSTRACT**

25 **Purpose:** Hearing aids play a pivotal role in mitigating the impact of hearing loss, yet their adoption  
26 and consistent usage remain suboptimal. Understanding the hearing aid needs of individuals with  
27 hearing loss is important to support uptake, use, and outcomes. The current study describes users'  
28 perspectives on how hearing aids can be improved.

29

30 **Method:** A cross-sectional, qualitative, content analysis design was used for an open-ended question  
31 from an online survey, exploring user perspectives on hearing aid improvements. Participants were  
32 adult hearing aid users in the United States, surveyed from the Hearing Tracker and Lexie Hearing user  
33 database.

34

35 **Results:** 628 participants (mean age = 66 years) were surveyed. The majority of participants used  
36 bilateral, behind-the-ear hearing aids that were obtained either through a hearing healthcare  
37 professional or online. Three domains, highlighting areas for hearing aid improvement, were  
38 identified. *1. Hearing aid features domain* describes user issues surrounding physical appearance and  
39 fit, general features, streaming, battery functionality, adjustments, smartphone applications and  
40 hearing aid related accessories. There was dissatisfaction with aesthetics and functionality, with a  
41 notable desire for improvements in physical appearance and fit (n=161), and features to improve self-  
42 efficacy. *2. Sound quality domain* described user issues surrounding sound perception and difficult  
43 situations. Participants highlighted unmet needs for clarity, especially in noisy environments (n=143).  
44 *3. Service-delivery domain* described user issues surrounding audiology services and general  
45 satisfaction, with criticisms centered on the high cost of hearing aids (n=193) and the credibility of  
46 hearing healthcare professionals.

47

48 **Conclusions:** Hearing aid users appreciate current technological advances but express a need for  
49 improvements, to better align devices with their requirements. Key areas include physical aesthetics,

50 user control over device adjustments, sound clarity, cost accessibility and trust between the user and  
51 hearing healthcare professional. Future designs should focus on features enhancing user autonomy  
52 and self-efficacy.

53

54

55

56

57

58

59

60

61

62

63

64

65

66

67

68

69

70

71

72

73

74

## 75 INTRODUCTION

76 Hearing healthcare has advanced rapidly in line with technological improvements. This growth aligns  
77 with an expanding need for its services, as the World Health Organisation (WHO) projects that more  
78 than 700 million individuals will require hearing rehabilitation by 2050 (World Health Organisation  
79 (WHO), 2021). The effectiveness of hearing aids as an intervention for hearing loss is well-documented  
80 and widely accepted (Picou, 2020; Ritter, Barker, & Scharp, 2020). Nevertheless, a significant  
81 proportion of individuals with disabling hearing loss remain without these devices (McCormack &  
82 Fortnum, 2013; Dillon, Day, Bant, & Munro, 2021). The utilization of hearing aids is influenced by  
83 multiple factors, including accessibility, individual perception of hearing loss and satisfaction with  
84 devices (Pouyandeh & Hoseinabadi, 2019). The present study aimed to describe user perspectives on  
85 hearing aids, with a focus on desired improvements, in order to enhance hearing aid use and improve  
86 hearing aid fitting outcomes.

87

88 Recent changes in hearing aid regulations in the U.S. have aimed to improve accessibility and  
89 affordability. In 2022, the U.S. Food and Drug Administration (FDA) sanctioned the sale of over-the-  
90 counter (OTC) hearing aids, despite some concerns regarding the quality and efficacy of this delivery  
91 model (Sheffield, Jacobs, & Ellis Jr., 2022; Manchaiah, et al., 2023; Almufarrij, Munro, Dawes, Stone,  
92 & Dillon, 2019). Consequently, individuals are no longer confined to acquiring hearing aids exclusively  
93 through hearing healthcare providers; they can now purchase OTC hearing aids without an audiologist  
94 consultation. These hearing aids typically present a more affordable and accessible option, and are  
95 available online or at retail outlets. The FDA specifies that OTC devices cater to individuals aged 18 or  
96 older, with perceived mild to moderate hearing loss (The Food and Drug Administration, 2023). Such  
97 industry changes signify a shift in hearing healthcare from a traditional paternalistic approach to one  
98 which encourages individuals to be active participants in their hearing rehabilitation (Taylor, 2016).  
99 This open market approach might have positive, yet to be observed, long-term implications for hearing  
100 aid adoption (Parmar, Mehta, Vickers, & Bizley, 2022).

101 In addition to issues surrounding accessibility and recent market changes, the hearing aid industry has  
102 continued to focus on advancements in technology, such as design, sound quality, and user-friendly  
103 features such as phone call streaming (Hesse & Hoppe, 2017). Despite these enhancements, rates of  
104 hearing aid non-use among both owners and non-owners remains relatively high (McCormack &  
105 Fortnum, 2013; Dillon, Day, Bant, & Munro, 2021; Oosthuizen, Manchaiah, Launer, & Swanepoel,  
106 2022). This is evident in the U.S., where estimates suggest that only 30% of adults aged 70 or older,  
107 with disabling hearing loss, actually use hearing aids (The National Institute on Deafness and Other  
108 Communication Disorders (NIDCD), 2021). Factors for non-use extend beyond accessibility and  
109 include internally motivated aspects like perceived non-necessity, stigmatization, lack of integration  
110 into daily living and deficient education, as well as externally motivated aspects such as discomfort,  
111 financial burden, professional distrust and prioritization of other needs (Ritter, Barker, & Scharp, 2020;  
112 Solheim, Gay, & Hickson, 2017; Desjardins & Sotelo, 2021). These findings highlight the complexity of  
113 hearing aid provision and the necessity to scrutinize factors influencing both dispensing and user  
114 satisfaction to optimize service delivery (Hesse & Hoppe, 2017). Understanding the heterogenous  
115 needs of individuals with hearing loss is key to improving hearing aid uptake and outcomes.

116

117 Contrary to low usage rates, several studies note high satisfaction rates among hearing aid users  
118 (Kozlowski, Ribas, Almeida, & Luz, 2017; Davidson, Marrone, Wong, & Musiek, 2021; Heselton,  
119 Bennett, Manchaiah, & Swanepoel, 2022). Hearing aid satisfaction has reportedly escalated from 58%  
120 in 1989 to 83% in 2022, based on consolidated data from the MarkeTrak survey (Powers & Carr, 2022).  
121 Key factors influencing satisfaction include improved communication ability and sound quality  
122 (Kozlowski, Ribas, Almeida, & Luz, 2017), and speech perception in noise (Davidson, Marrone, Wong,  
123 & Musiek, 2021). Recently, Bennett, et al. (2021) examined online reviews from hearing aid users and  
124 found that while hearing aid benefit was perceived as high from users answering multiple-choice  
125 questions, there were key factors in reviews which indicated barriers to success. These included  
126 factors such as cost, physical fit, hearing in noisy environments and technical difficulties. Using the

127 same dataset, Manchaiah et al. (2021) conducted a linguistic analysis of online reviews from hearing  
128 aid users and reported that while hearing aid benefit and satisfaction was high, clinic-visits and cost  
129 of hearing aids often negatively offset this positive impact. A key takeaway from these studies is that  
130 while hearing aid user benefit and satisfaction is high in terms of overall improved communication and  
131 sound detection, they report dissatisfaction on specific issues such as cost and speech clarity in the  
132 presence of background noise . This identifies the need for potential changes to hearing aids, as well  
133 as service delivery models.

134

135 Studies on hearing aid benefit and satisfaction are generally measured using quantitative patient-  
136 reported outcome measures, leading to a scarcity of qualitative research exploring hearing aid use  
137 and associated satisfaction. Qualitative research has become increasingly important in audiology  
138 (Oosthuizen, Manchaiah, Launer, & Swanepoel, 2022), with these types of studies providing valuable  
139 insights into user perspectives and needs. Oosthuizen, Manchaiah, Launer, & Swanepoel (2022)  
140 conducted a systematic review of qualitative studies exploring hearing aid user experiences. Their  
141 review included twenty-five studies which discussed factors surrounding adoption, use and sub-  
142 optimal use of hearing aids. The study highlighted the complexity of multiple factors affecting hearing  
143 aid use, and the significance of qualitative data in understanding the user experience holistically. As  
144 opposed to previous studies which quantified hearing aid use and satisfaction, the present study's  
145 qualitative analyses exposed common details in hearing aid user experiences and their impact,  
146 revealing areas of concern and insight into user expectations. User-reported insights into hearing aid  
147 experiences are available on various online platforms such as Hearing Tracker  
148 (<https://www.hearingtracker.com>) and Soundly (<https://www.soundly.com>). These types of  
149 platforms serve to facilitate open, unbiased consumer dialogue and connect individuals with products  
150 and services. Exploring unmet needs of hearing aid users across these platforms may provide insights  
151 that could help mitigate high rates of non-use, while fostering meaningful improvements in  
152 satisfaction and benefit rates. The present study therefore utilised responses from users of the online

153 Hearing Tracker database and an OTC provider, Lexie Hearing, to gather data on hearing aid user  
154 perspectives. This study specifically explored user perspectives on improving hearing aids, using  
155 qualitative methodology.

156

## 157 **METHOD**

158 The study used a cross-sectional survey design. Qualitative content analysis was used to analyse  
159 responses to an open-ended question from a survey sent to U.S. hearing aid users who were part of  
160 the Hearing Tracker database, or had purchased Lexie Hearing aids. An inductive approach was used  
161 for data analysis. Due to the qualitative nature of the study and its large dataset, no pre-existing  
162 hypotheses were developed. Content analysis was used for its structured approach, to explore all  
163 aspects of the data and identify recurring concepts in responses, thereby informing systematic  
164 categorization and conclusions (Manchaiah, Beukes, & Roeser, 2022). Relevant institutional  
165 clearances were obtained from Lamar University's Institutional Review Board (IRB-FY21-248) and the  
166 University of Pretoria's Research Ethics Committee (HUM033/0822) prior to data collection and  
167 analysis.

168

169 Two reporting guidelines were used when describing the methodology and results of the study: the  
170 equator network checklist for reporting results of Internet e-surveys (CHERRIES) (Eysenbach, 2004),  
171 and domain 3 of the consolidated criteria for reporting qualitative research (COREQ) (Tong, Sainsbury,  
172 & Craig, 2007).

173

## 174 **PARTICIPANTS**

175 Purposive sampling was used to recruit participants who were users of the Hearing Tracker database  
176 (<http://www.hearingtracker.com>) and users of the Lexie hearing aids (<http://www.lexiehearing.com>).

177 Hearing Tracker is an online consumer forum that showcases user reviews and experiences with  
178 hearing aids. Individuals surveyed from this forum obtained their hearing aids from a healthcare  
179 professional (HCP) at a clinic or hearing centre, through the conventional, in-person service delivery  
180 model. The Lexie Hearing OTC model provides self-fitting hearing aids to individuals online, or in-  
181 store, with exclusively online support.

182

183 Participants that were included in the study were adults (>18 years old) presenting with varying  
184 degrees of hearing loss. Individuals who utilised direct-to-consumer (DTC) hearing devices such as  
185 Personal Sound Amplification Products (PSAPs) and those fitted with hearing aids during early  
186 childhood were excluded. According to the FDA, PSAPs are consumer electronics intended for  
187 individuals with normal hearing, to amplify sounds for recreational activities (U.S. Food and Drug  
188 Administration, 2021). Responses that did not answer, or were irrelevant to, the survey's open-ended  
189 question that formed the basis of this study, were also excluded. Seven hundred and twenty-seven  
190 (727) responses were captured. A total of 628 responses were analysed after exclusions (399 from  
191 Hearing Tracker and 229 from Lexie Hearing).

192

### 193 **SURVEY**

194 The current study was nested in a larger online survey that focused on hearing aid user experiences.  
195 The survey was completed in October and November 2021. The researchers developed and shared  
196 the survey with Hearing Tracker and Lexie Hearing who emailed it to their respective users. The survey  
197 was comprised of an introductory page describing the study and requesting informed consent from  
198 the participants (a tick box was used), 33 closed-ended questions and 4 open-ended questions. There  
199 were five sections: 1) demographic and hearing aid related information (structured questions), 2)  
200 hearing aid experiences (four open-ended questions), 3) International Outcomes Inventory for  
201 Hearing Aids (IOI-HA) (Cox & Alexander, 2002), 4) general health, well-being and social network



202 information and 5) further demographic information. The open-ended questions in section two were  
203 developed by two audiologists (DS and VM) and social psychologists (Jamie Pennebaker and Ryan  
204 Boyd). The Hearing Tracker survey included a minimum word count of 20 words, whereas, the Lexie  
205 Hearing survey did not include a minimum word count. However, all responses that sufficiently  
206 answered the open-ended question, irrespective of length, were included in the analysis. As an  
207 example, some participants answered the question with one word: “rechargeable”. This was deemed  
208 to indicate their preference for a rechargeable device, since the question posed to them requested  
209 information on their desired changes to hearing aids, to improve usefulness. However, the authors  
210 recognize that some responses such as these had limited contextual information which is highlighted  
211 as a key limitation of the study.

212

213 The survey was initially piloted by four audiologists. After revisions, it was imported to Qualtrics  
214 (Qualtrics, Provo, UT) and further reviewed. Item randomisation was not used and respondents were  
215 not given the opportunity to edit submitted responses. No data which was personally identifiable was  
216 collected.

217

218 For the purpose of this study, data from section one in the survey (demographic and hearing aid-  
219 related information) and from section two (one specific open-ended question on hearing aid  
220 experiences) was used. The open-ended question from the survey, which was analysed in the current  
221 study was: *“We talk to audiologists and hearing aid companies. Tell us how you would like hearing aids  
222 to change to be more useful for you and the people around you. Please be honest. We really would like  
223 your thoughts and feelings about this. Your comments will help us when we talk to people in the  
224 industry.”*

225

226 **DATA ANALYSIS**

227 The Statistical Package for the Social Sciences (SPSS) version 28 was used to analyse the demographic  
228 survey data, in order to obtain descriptive statistics. Participant responses to the open-ended question  
229 were analysed using inductive content analysis as described by Graneheim & Lundman (2004). Survey  
230 responses were consolidated on a Microsoft Excel spreadsheet and allocated a numerical participant  
231 identity, to form a de-identified dataset. The data was first examined through data immersion. Each  
232 response was divided into meaning units and corresponding codes were generated. The Microsoft  
233 Excel spreadsheet containing the participant responses was developed into a code book. Codes were  
234 grouped into different categories and sub-categories to identify patterns for meaningful  
235 interpretation.

236

237 For the purpose of trustworthiness, data analysis was extensively documented at each stage, ensuring  
238 clear and replicable results as recommended by Manchaiah, Beukes, & Roeser (2022). Documentation  
239 included original survey responses and all code books leading to the final presentation of the data.  
240 Initial coding and categorisation was performed by the primary author (ND) and was cross-checked by  
241 two researchers (EWB and VM) to ensure consistency during coding and category development.

242

## 243 **RESULTS**

244 Participant ages ranged from 24-93 years old, with an average age of 66 years (13.4 SD). Participants  
245 comprised 62% (n=386) males, 38% (n=239) females and 0.5% (n=3) either non-binary or preferring  
246 not to answer. Hearing aids were obtained from a private or university hearing clinic by 36% (n=225)  
247 of participants, a discount warehouse by 12% (n=74), Internet or online store by 42% (n=264), from a  
248 pharmacy or hearing centre by 0.5% (n=3) and from a hearing professional visiting the participant's  
249 home by 0.3% (n=2). Additionally, 10% (n=60) of participants obtained their hearing aids from other  
250 sources, such as the U.S. veterans administration. Almost all participants were bilateral (93%, n=582),  
251 behind-the-ear (93%, n=586) hearing aid users. Participants were asked to provide a self-report on

252 their unaided hearing status: 1% (n=4) felt that they could hearing everything without hearing aids,  
253 27% (n=168) felt that they sometimes didn't hear speech, 52% (n=329) felt that they regularly didn't  
254 hear speech and 20% (n=127) of participants felt that they could almost never hear speech without  
255 hearing aids.

256

257 Qualitative analysis identified three domains, composed of 12 categories and 57 sub-categories. No  
258 considerable differences were observed between responses from individuals with healthcare  
259 professional prescribed hearing aids and OTC hearing aids.

260

#### 261 **Domain One: Hearing Aid Feature Suggestions**

262 Domain one included seven categories and thirty sub-categories (see Table 1) relating to the physical  
263 appearance and fit (161), general features (143), streaming (133), battery functionality (103),  
264 adjustments (40), user-centric App (47) and accessories (8) of hearing aids. This domain described a  
265 generally negative user experience with hearing aids. The majority of responses in this domain related  
266 to the category regarding the physical appearance and fit of hearing aids. A minority of participants  
267 felt that hearing aids should be more visible. For this minority specifically, stigma associated with  
268 hearing aids did not appear to be a concern. However, the majority of participants felt that hearing  
269 aids should be less visible and more aesthetically pleasing. The category regarding general features  
270 was also prominent, with some participants asking for hearing aids to be simpler to use, and others  
271 favouring technological advancements, even suggesting features which they would like to see  
272 developed (further detail is provided in the discussion). For example, *"I want aids to be helpful, useful*  
273 *and functional. I don't really need all of the bells and whistles that come with some aids, but prefer an*  
274 *app that works all of the time, not just occasionally"* (P309, male, 74). This category also featured a  
275 majority request for waterproof hearing aids. For example, *"More comfortable and waterproof. I got*  
276 *caught in the rain the other day and I was worried about them!"* (P110, female, 67).

277 Bluetooth streaming was identified as an essential feature that required further development as  
278 illustrated here, *“Have a big issue with audiologists that don't think that connectivity (phone app/TV*  
279 *streamer/remote mic) is part of fitting the hearing aids and vendors don't want customers to call them*  
280 *when the add-on don't work” (P359, male, 69)*. Participants also emphasised a need to have more  
281 control over fine-tuning their devices, and for remote assistance from professionals to avoid travelling.

282

### 283 **Domain Two: Hearing Aid Sound Quality Suggestions**

284 Domain two included two categories and fourteen sub-categories (see Table 2) relating to sound  
285 perception (143) and difficult situations (139). Responses in this domain indicated that user sound  
286 quality needs were yet to be met. The sound perception category featured a majority of participants  
287 who felt that sound clarity needed to be improved. They described sound clarity as independent from  
288 sound volume as illustrated here, *“Hearing aids always make conversation loud enough - they fail in*  
289 *fulfilling complete clarity in the conversations.” (P622, male, 73)*. Participants also wanted hearing aids  
290 to produce output that sounded more *“natural”*.

291

292 The difficult situations category emphasised issues with hearing in the presence of background noise,  
293 for example, *“I can't believe with the technology available today that a hearing aid can't be designed*  
294 *to work better in noisy places” (P384, 76, male)*. Participants wanted to see improvements in noise  
295 reduction technology as well as speech in noise perception. Some participants felt that hearing aid  
296 fittings did not prepare users for hearing sound in the real world, which presents various sound  
297 environments.

298

### 299 **Domain Three: Hearing Aid Service-Delivery Suggestions**

300 Domain three included three categories and thirteen sub-categories (see Table 3) relating to the cost  
301 (193), audiology services (93) and general satisfaction (90) with hearing aids. Responses in this domain  
302 conveyed an undertone of criticism and concern with regards to consumer access to hearing aids,  
303 credible information and person-centred care. The category regarding cost was most prominent.  
304 Participants suggested that the cost of hearing aids and services be more affordable, and that  
305 audiologists present as more transparent and credible when communicating charges, for example,  
306 *“There is NO transparency regarding prices. When I was diagnosed with hearing loss the sales person*  
307 *came rushing in to sell me a hearing aid. I regret signing a lease! ... While researching brands and prices*  
308 *I became aware of the lack of transparency for pricing, it appears this lack of transparency is*  
309 *throughout this industry. How will I know if I am getting a discount if the price is not obvious?” (P247,*  
310 *female, 67).*

311

312 The category regarding audiology services emphasised a desire for access to reliable information and  
313 improved audiologist competency. Participants wanted audiologists to understand their needs better,  
314 include them in decision-making and employ best practices during clinic visits. Some participants also  
315 stated their general satisfaction with hearing aids, noting current innovations in technology to be  
316 favourable. A minority stated a general dissatisfaction, having had disappointing experiences with  
317 previous hearing aids not meeting their expectations.

## 318 **DISCUSSION**

319 The study explored potential improvements in hearing aids from users' perspectives, revealing  
320 valuable insights on both hearing devices and service delivery. Despite general satisfaction with  
321 hearing aids, as noted in the current study and previous studies (Kozłowski, Ribas, Almeida, & Luz,  
322 2017; Davidson, Marrone, Wong, & Musiek, 2021; Powers & Carr, 2022), there was a pervasive desire  
323 for technological and service delivery enhancements. In this study, hearing aids were described in  
324 three domains focusing on (a) general features and functionalities, (b) sound quality and (c) service  
325 delivery. Similarly, Bennett, et al., (2021) identified high user satisfaction and benefit from hearings  
326 aids among users, but with specific needs towards improved hearing aid experiences.

327

### 328 **Hearing Aid Features**

329 Participants displayed divergent preferences towards advanced features. Some favoured simplicity,  
330 while others appreciated new technologies, as also reported by Gomez, Habib, Maidment, & Ferguson  
331 (2022). Their study noted digital literacy as a significant factor in successful hearing aid use but found  
332 that users, despite sufficient digital literacy, struggled with hearing aid App technology due to manual  
333 dexterity issues. In the present study, participants highlighted a need for hearing aids themselves and  
334 associated Apps to be more user-friendly to improve ease of use. Notably, users desired features  
335 signalling hearing difficulty to others (such as a blinking light controlled via an app), and built-in  
336 mechanisms aiding acclimatization (such as indicators for correct insertion and auditory fatigue). Self-  
337 adjustment opportunities for sound quality were also desired to improve user experience. Participants  
338 specifically asked for more control to fine-tune their own hearing aids. This preference indicates a  
339 significant shift from clinician-driven prescriptive measures, toward user-centered options, reflecting  
340 a broader desire for autonomy and self-efficacy in hearing healthcare.

341

342 This theme of user empowerment was further echoed in participants' calls for remote consultations  
343 and a more collaborative approach from audiologists. The concept of user control and empowerment  
344 was also reported by Gomez, Habib, Maidment, & Ferguson (2022) in their user narrative, where  
345 individuals preferred using hearing aid Apps to make real-time adjustments to facilitate  
346 communication. Supporting this trend toward self-management, Ross (2020) reported that hearing  
347 aid consumers often respond positively to marketing strategies that promote user autonomy.  
348 Furthermore, Gomez and Ferguson (2020) highlighted the importance of empowering individuals with  
349 knowledge for self-management even before the fitting of hearing aids, finding this approach central  
350 to improving user outcomes. Lastly, Fuentes-López et al. (2019) also established a positive correlation  
351 between hearing aid adherence and self-efficacy, noting that higher levels of education were  
352 associated with increased self-efficacy. It is necessary to highlight the use of a personalized approach  
353 that takes into account individual users' educational backgrounds, socio-economic status,  
354 geographical region and access to resources (e.g. Wi-Fi) and other unique needs to ensure favourable  
355 outcomes.

356

357 While technological advancements pose great user advantages, they can be accompanied by technical  
358 challenges. In the present study, participants identified Bluetooth connectivity as critical yet  
359 problematic, a finding consistent with prior studies (Murdin et al., 2022; Bennett et al., 2021;  
360 Vercammen et al., 2023). The issue was two-fold: firstly, pairing to Apps and devices presented  
361 technical difficulties, and secondly, once paired for streaming specifically, the streamed signal was  
362 perceived as poor in quality. Participants felt that audiologists neglected connectivity issues by not  
363 addressing them. Previous research (e.g., Murdin et al., 2022), similarly found Bluetooth functionality  
364 to be a common source of dissatisfaction among hearing aid users. Bennett, et al., (2021) also found  
365 that users enjoyed streaming functionality as a feature, but expressed negative opinions regarding  
366 technical difficulties. Vercammen, et al., (2023) cited Bluetooth connectivity issues being a cause of

367 frustration when discussing the real-life experiences of hearing aids users. This highlights both, the  
368 need for reviewing digital literacy requirements during service delivery, and the need for hearing  
369 professionals to provide support for technical issues.

370

371 Beyond software feature improvements, hearing aid hardware suggestions centred around the need  
372 for moisture resistance, improved physical comfort and aesthetic appeal. Previous research has shown  
373 that moisture damage is one of the most common reasons for hearing aid repairs (Hay & Zielinski,  
374 2022). The issues of comfort and aesthetic appeal is also not new, with previous studies citing this as  
375 a significant factor for user satisfaction (Chundu, et al., 2021; Bennett, et al., 2021). Participant  
376 responses in the present study emphasized the need for hearing aids to be more closely aligned with  
377 active lifestyles. It is essential that hardware technology is long-wearing and comfortable, as hearing  
378 aid users become more reliant on their devices as wearable technology. Holt (2023) described  
379 wearable technology, such as Bluetooth streaming, as being central to hearing devices and improving  
380 communication. As the narrative surrounding hearing loss-related stigma progresses, evidenced by  
381 previous studies such as Barker & Scharp (2021), there appears to be a generational movement away  
382 from the traditional mindset of hearing aids being simply a medical device, to being considered more  
383 as a wearable technology. This is particularly true in the consumer sphere of OTC hearing aids. In the  
384 present study, participants drew parallels between hearing aids and earbuds in terms of aesthetics  
385 and function. The majority of participants wanted hearing aids to be less visible, with one participant  
386 requesting them to look more "*humanised*", and others preferring the aesthetics to be more in line  
387 with a sophisticated gadget. This illuminates the profile of the contemporary hearing aid consumer,  
388 who views hearing loss less as a "*personal shortcoming*", and more as a "*relational reality*" (Barker &  
389 Scharp, 2021). It is noteworthy that issues surrounding hearing loss-related stigma and digital literacy  
390 still remain relevant despite not being a focus of this study.



391 It should also be noted that modern hearing aids have already included a large number of suggestions  
392 made by users. These observations highlight the need for audiologists to assist patients to find the  
393 right product that fits their personal preferences and needs. Using decision aids (Taylor & Weinstein,  
394 2015), and providing trial periods may help resolve some of the issues mentioned by study  
395 participants.

396

### 397 **Hearing Aid Sound Quality**

398 In the second domain on hearing aid sound quality suggestions, participants highlighted the intrinsic  
399 auditory processing challenges that they expect hearing aids to mitigate. Despite recent technological  
400 advancements, users reported persistent difficulties with understanding speech in noisy  
401 environments, revealing a notable gap between audibility and comprehension. This aligns with  
402 findings from Bennett et al. (2021), who discussed similar unmet user needs in relation to challenging  
403 listening situations. These findings underscore the need for enhanced real-world simulations in clinical  
404 settings to better prepare users for diverse listening environments, and emphasize the importance of  
405 aural rehabilitation as a part of best practices (Oeding, 2022). Despite the significant efforts from the  
406 industry to improve hearing aid signal processing algorithms and associated sound quality, anecdotal  
407 reports as well as research studies have demonstrated that hearing aid sound quality is still a major  
408 issue for many users (Bennett et al., 2021; Oeding, 2022; Heselton, Bennett, Manchaiah, & Swanepoel,  
409 2022). However, it is hoped that the use of Artificial Intelligence/ Machine Learning (AI/ML) algorithms  
410 will help improve this in the coming years (Lesica, et al., 2021).

411

### 412 **Hearing Aid Service-Delivery**

413 In the third domain, hearing aid user attitudes towards service-delivery by audiologists varied widely,  
414 reflecting concerns about costs, professional competency and about professionals truly understanding

415 their needs. Participants noted a lack of transparency in the industry, particularly surrounding the cost  
416 of hearing aids, and called for more inclusivity in decision-making processes regarding intervention.  
417 This perspective aligns with the current broader transition in healthcare, moving from paternalistic  
418 approaches to more person-centred care (Bundesen, 2019). This emerging model prioritizes  
419 partnerships between patients and professionals, emphasizing collaborative strategies to meet  
420 individual needs more effectively (Delaney, 2018). Mahomed-Asmail et al. (2023) found that  
421 audiologists are receptive to this person-centered approach, which has been associated with  
422 improved patient satisfaction when care is delivered from a holistic perspective. Individualized care  
423 and prioritization of patient goals was highlighted as a key element for enhancing treatment outcomes  
424 in their study. This individualised approach was also cited by Bennett, et al. (2021) as being central to  
425 addressing patient needs, when they explored online consumer hearing aid reviews. Participants in  
426 the present study expressed the need for reliable information to inform decision making, and voiced  
427 concerns that audiologists were not transparent due to financial affiliations with hearing aid sales.  
428 They also questioned the use of best practices from their audiologists. Participant responses revolved  
429 around a common theme of impaired trust with audiologists, which is central to patient outcomes  
430 (Oosthuizen, Manchaiah, Launer, & Swanepoel, 2022). Preminger, Oxenbøll, Barnett, Jensen, &  
431 Laplante-Lévesque (2015) found that displaying professional competency, encouraging joint  
432 decision making and abstaining from an emphasis on hearing aid sales helps foster trust between  
433 audiologists and patients. The responses from participants in the present study paint a picture of a  
434 contemporary consumer who desires hearing aids to function as a tool for user autonomy, self-efficacy  
435 and consumer empowerment. The position of the audiologist, from the perspective of the hearing aid  
436 user, manifests as a facilitator in the hearing healthcare journey.

437

438

439

## 440 **Study Limitations**

441 Our study had some limitations. Firstly, due to self-selected users completing the survey there was a  
442 high likelihood of sampling bias. The survey was conducted online and also included participants who  
443 had obtained their hearing aids through the online OTC service delivery model. It is possible that these  
444 individuals are more likely to present with higher levels of digital literacy, and a preference for  
445 advanced hearing aid features. The results could under-represent individuals with a lack of access to  
446 technology or a certain level of digital literacy. Second, the responses from Lexie Hearing users were  
447 generally shorter due to the absence of a minimum word limit, in contrast to the Hearing Tracker  
448 database that required at least 20 words. Third, the open-ended survey question was multifaceted to  
449 motivate the users to write more detailed notes, the wordy question could have proven complex to  
450 some respondents. Fourth, many users only provided limited text that did not provide much context  
451 to what users were saying when analysing the data. Fifth, the study reported on a large amount of  
452 information, from a large dataset, with a focus on describing prevalent hearing aid user desires. Adding  
453 an additional layer of complexity through subgroup analyses was beyond the scope of this article.  
454 Future considerations could look at differences in responses according to sub-groups (for example,  
455 differences in responses between individuals with various levels of hearing difficulty, age or place of  
456 hearing aid purchase). Lastly, participants were only based in the U.S., which could mean that findings  
457 have limited generalisability to other populations.

458

## 459 **CONCLUSION**

460 Hearing aid users highlighted several areas for improvement, underscoring the need for greater user  
461 autonomy, reduced moisture damage, minimized Bluetooth connectivity issues, improved sound  
462 clarity and more effective service delivery. While some challenges, like device appearance, comfort,  
463 cost and sound quality resonate with previous research, others such as features fostering user  
464 autonomy are relatively novel, particularly among individuals with a higher level of digital literacy and

465 self-efficacy for hearing aid technology. Moreover, the suggestions about service delivery have  
466 implications for policy making and building trust by using person-centred strategies during hearing aid  
467 consultation sessions. This study, thus, contributes to the growing evidence base on hearing aid user  
468 satisfaction and highlights user-centred suggestions for improved experiences and satisfaction with  
469 hearing aids.

470

#### 471 **ACKNOWLEDGMENTS**

472 We would like to acknowledge Dr Ilze Oosthuizen for guidance during data analysis. No funding was  
473 involved in this work.

474

#### 475 **DATA AVAILABILITY STATEMENT**

476 Data is not publicly available due to institutional regulations, but access may be granted upon request  
477 from corresponding author, De Wet Swanepoel, in compliance with the specific data access policies  
478 of the institution ([https://www.up.ac.za/media/shared/12/ZP\\_Files/research-data-management-  
479 policy\\_august-2018.zp161094.pdf](https://www.up.ac.za/media/shared/12/ZP_Files/research-data-management-policy_august-2018.zp161094.pdf)).

480

481

482

483

484

485

486

487

488

489 **REFERENCES**

- 490 Almufarrij, I., Munro, K. J., Dawes, P., Stone, M. A., & Dillon, H. (2019). Direct-to-Consumer Hearing  
491 Devices: Capabilities, Costs, and Cosmetics. *Trends in Hearing, 23*.  
492 doi:<https://doi.org/10.1177/2331216519858301>
- 493 Barker, B. A., & Scharp, K. M. (2021). "I Have to Social Norm This": Making Meaning of Hearing Loss  
494 from the Perspective of Adults Who Use Hearing Aids. *Health Communication, 36*(6), 774-  
495 781. doi: <https://doi.org/10.1080/10410236.2020.1712523>
- 496 Bennett, R. J., Swanepoel, D., Ratinaud, P., Bailey, A., Pennebaker, J. W., & Manchaiah, V. (2021).  
497 Hearing aid acquisition and ownership: what can we learn from online consumer reviews?  
498 *International Journal of Audiology, 60*(11), 917-926. doi:  
499 <https://doi.org/10.1080/14992027.2021.1931487>
- 500 Bundesen, L. L. (2019). *PCC 2.0: From Awareness to Action!* Retrieved from The Hearing Review:  
501 <https://hearingreview.com/hearing-loss/patient-care/pcc-2-0-from-awareness-to-action>
- 502 Chundu, S., Allen, P. M., Han, W., Ratinaud, P., Krishna, R., & Manchaiah, V. (2021). Social  
503 representation of hearing aids among people with hearing loss: an exploratory study.  
504 *International Journal of Audiology, 60*(12), 964-978.
- 505 Cox, R. M., & Alexander, G. C. (2002). The International Outcome Inventory for Hearing Aids (IOI-HA):  
506 psychometric properties of the English version: El Inventario Internacional de Resultados para  
507 Auxiliares Auditivos (IOI-HA): propiedades psicometricas de la version en ingles. *International*  
508 *Journal of Audiology, 41*(1), 30-35. doi: <https://doi.org/10.3109/14992020209101309>
- 509 Davidson, A., Marrone, N., Wong, B., & Musiek, F. (2021). Predicting Hearing Aid Satisfaction in  
510 Adults: A Systematic Review of Speech-in-noise Tests and Other Behavioral Measures. *Ear*  
511 *and Hearing, 42*(6), 1485–1498. Retrieved July 19, 2022

512 Delaney, L. J. (2018). Patient-centred care as an approach to improving health care in Australia.  
513 *Collegian*, 25(1), 119-123. Retrieved May 17, 2023, from  
514 <https://doi.org/10.1016/j.colegn.2017.02.005>

515 Desjardins, J. L., & Sotelo, L. R. (2021). Self-Reported Reasons for the Non-Use of Hearing Aids Among  
516 Hispanic Adults With Hearing Loss. *American Journal of Audiology*, 30(3), 709-716. doi:  
517 [https://doi.org/10.1044/2021\\_AJA-21-00043](https://doi.org/10.1044/2021_AJA-21-00043)

518 Dillon, H., Day, J., Bant, S., & Munro, K. J. (2021). Adoption, use and non-use of hearing aids: a robust  
519 estimate based on Welsh national survey statistics. *International Journal of Audiology*, 59(8),  
520 567-573. doi: <https://doi.org/10.1080/14992027.2020.1773550>

521 Eysenbach, G. (2004). Improving the Quality of Web Surveys: The Checklist for Reporting Results of  
522 Internet E-Surveys (CHERRIES). *Journal of Medical Internet Research*, 6(3). doi:  
523 <https://doi.org/10.2196/jmir.6.3.e34>

524 Fuentes-López, E., Fuente, A., Valdivia, G., & Luna-Monsalve, M. (2019). Does educational level  
525 predict hearing aid self-efficacy in experienced older adult hearing aid users from Latin  
526 America? Validation process of the Spanish version of the MARS-HA questionnaire. *PLoS One*,  
527 14(12). Retrieved from <https://doi.org/10.1371/journal.pone.0226085>

528 Gomez, R., & Ferguson, M. (2020). Improving self-efficacy for hearing aid self-management: the early  
529 delivery of a multimedia-based education programme in first-time hearing aid users.  
530 *International Journal of Audiology*, 59(4), 272-281.

531 Gomez, R., Habib, A., Maidment, D. W., & Ferguson, M. A. (2022). Smartphone-Connected Hearing  
532 Aids Enable and Empower Self-Management of Hearing Loss: A Qualitative Interview Study  
533 Underpinned by the Behavior Change Wheel. *Ear and Hearing*, 43(3), 921-932. doi:  
534 <https://doi.org/10.1097/AUD.0000000000001143>

535 Graneheim, U. H., & Lundman, B. (2004). Qualitative content analysis in nursing research: concepts,  
536 procedures and measures to achieve trustworthiness. *Nurse Education Today*, 24(2), 105-  
537 112. doi: <https://doi.org/10.1016/j.nedt.2003.10.001>

538 Hay, M. E., & Zielinski, R. Q. (2022). Moisture in Hearing Instruments: Problematic, Prevalent, and  
539 Professionally Preventable. *The Hearing Journal*, 75(3), 20-24. doi:  
540 <https://doi.org/10.1097/01.HJ.0000823376.60686.5d>

541 Heselton, T., Bennett, R. J., Manchaiah, V., & Swanepoel, D. (2022). Online Reviews of Hearing Aid  
542 Acquisition and Use: A Qualitative Thematic Analysis. *American Journal of Audiology*, 1-15.  
543 doi: [https://doi.org/10.1044/2021\\_AJA-21-00172](https://doi.org/10.1044/2021_AJA-21-00172)

544 Hesse, G., & Hoppe, U. (2017). Hearing aids: indications, technology, adaptation, and quality control.  
545 *GMS Current Topics Otorhinolaryngol Head Neck Surgery*, 16, 1-24. doi:  
546 <https://doi.org/10.3205/cto000147>

547 Holt, C. (2023). Wearable Technologies in Hearing Aids Ring True with Consumers, Providers. *The*  
548 *Hearing Journal*, 76(02), 28-29. doi: <https://doi.org/10.1097/01.HJ.0000919788.69576.f3>

549 Kozlowski, L., Ribas, A., Almeida, G., & Luz, I. (2017). Satisfaction of Elderly Hearing Aid Users.  
550 *International Archives of Otorhinolaryngology*, 21(01), 92-96. doi:[https://doi.org/10.1055/s-](https://doi.org/10.1055/s-0036-1579744)  
551 [0036-1579744](https://doi.org/10.1055/s-0036-1579744)

552 Lesica, N. A., Mehta, N., Manjaly, J. G., Deng, L., Wilson, B. S., & Zeng, F.-G. (2021). Harnessing the  
553 power of artificial intelligence to transform hearing healthcare and research. *Nature Machine*  
554 *Intelligence*, 3, 840–849. doi:<https://doi.org/10.1038/s42256-021-00394-z>

555 Mahomed-Asmail, F., Hlayisi, V.-G., Joubert, K., Metcalfe, L., Graham, M. A., & Swanepoel, D. (2023).  
556 Person-centered care: preferences and predictors in speech-language pathology and  
557 audiology practitioners. *Frontiers in Psychology*, 14. Retrieved from  
558 <https://doi.org/10.3389/fpsyg.2023.1162588>

559 Manchaiah, V., Beukes, E., & Roeser, R. J. (2022). *Evaluating and Conducting Research in Audiology*.  
560 San Diego: Plural Publishing Incorporated. Retrieved March 13, 2022, from  
561 [https://ebookcentral-proquest-com.uplib.idm.oclc.org/lib/pretoria-](https://ebookcentral-proquest-com.uplib.idm.oclc.org/lib/pretoria-ebooks/reader.action?docID=6499979)  
562 [ebooks/reader.action?docID=6499979](https://ebookcentral-proquest-com.uplib.idm.oclc.org/lib/pretoria-ebooks/reader.action?docID=6499979)

563 Manchaiah, V., Sharma, A., Rodrigo, H., Bailey, A., De Sousa, K. C., & Swanepoel, D. (2023). Hearing  
564 Healthcare Professionals' Views about Over-The-Counter (OTC) Hearing Aids: Analysis of  
565 Retrospective Survey Data. *Audiology Research*, 13(2), 185–195. Retrieved from  
566 <https://doi.org/10.3390/audiolres13020018>

567 Manchaiah, V., Swanepoel, D., Bailey, A., Pennebaker, J. W., & Bennett, R. J. (2021). Hearing Aid  
568 Consumer Reviews: A Linguistic Analysis in Relation to Benefit and Satisfaction Ratings.  
569 *American Journal of Audiology*, 30(3), 761-768. Retrieved from [https://doi-](https://doi-org.uplib.idm.oclc.org/10.1044/2021_AJA-21-00061)  
570 [org.uplib.idm.oclc.org/10.1044/2021\\_AJA-21-00061](https://doi-org.uplib.idm.oclc.org/10.1044/2021_AJA-21-00061)

571 McCormack, A., & Fortnum, H. (2013). Why do people fitted with hearing aids not wear them?  
572 *International Journal of Audiology*, 52(5), 360-368. Retrieved July 18, 2022, from  
573 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3665209/>

574 Murdin, L., Sladen, M., Williams, H., Bamio, D.-E., Bibas, A., Kikidis, D., . . . Pontoppidan, N. H.  
575 (2022). EHealth and Its Role in Supporting Audiological Rehabilitation: Patient Perspectives  
576 on Barriers and Facilitators of Using a Personal Hearing Support System With Mobile  
577 Application as Part of the EVOTION Study. *Frontiers*, 9.  
578 [doi:https://doi.org/10.3389/fpubh.2021.669727](https://doi.org/10.3389/fpubh.2021.669727)

579 Oeding, K. (2022). Improving hearing aid outcomes in background noise: An investigation of outcome  
580 measures and patient factors. *Doctoral thesis*. University of Minnesota's Digital Conservancy.



581 Oosthuizen, I., Manchaiah, V., Launer, S., & Swanepoel, D. (2022). Hearing aid Experiences of Adult  
582 Hearing aid Owners During and After Fitting: A Systematic Review of Qualitative Studies.  
583 *Trends in Hearing, 26*. doi:<https://doi.org/10.1177/23312165221130584>

584 Parmar, B. J., Mehta, K., Vickers, D. A., & Bizley, J. K. (2022). Experienced hearing aid users'  
585 perspectives of assessment and communication within audiology: a qualitative study using  
586 digital methods. *International Journal of Audiology, 61*(11), 956-964.  
587 doi:<https://doi.org/10.1080/14992027.2021.1998839>

588 Picou, E. M. (2020). MarkeTrak 10 (MT10) Survey Results Demonstrate High Satisfaction with and  
589 Benefits from Hearing Aids. *Seminars in Hearing, 41*(1), 21–36.  
590 doi:<https://doi.org/10.1055/s-0040-1701243>

591 Pouyandeh, M. H., & Hoseinabadi, R. (2019, July). Factors Influencing the Hearing Aids Use and  
592 Satisfaction: A Review Study. *Journal of Modern Rehabilitation, 13*(3), 137-146. doi:  
593 <http://dx.doi.org/10.32598/JMR.13.3.137>

594 Powers, T. A., & Carr, K. (2022). MarkeTrak 2022: Navigating the Changing Landscape of Hearing  
595 Healthcare. *The Hearing Review, 29*(5), 12-17. Retrieved July 24, 2022, from  
596 [https://hearingreview.com/inside-hearing/research/marketrak-2022-navigating-the-](https://hearingreview.com/inside-hearing/research/marketrak-2022-navigating-the-changing-landscape-hearing-healthcare)  
597 [changing-landscape-hearing-healthcare](https://hearingreview.com/inside-hearing/research/marketrak-2022-navigating-the-changing-landscape-hearing-healthcare)

598 Preminger, J. E., Oxenbøll, M., Barnett, M. B., Jensen, L. D., & Laplante-Lévesque, A. (2015).  
599 Perceptions of adults with hearing impairment regarding the promotion of trust in hearing  
600 healthcare service delivery. *International journal of audiology, 54*(1), 20–28. doi:  
601 <https://doi.org/10.3109/14992027.2014.939776>

602 Ritter, C. R., Barker, B. A., & Scharp, K. M. (2020). Using attribution theory to explore the reasons  
603 adults with hearing loss do not use their hearing aids. *PLOS One, 15*(9). doi:  
604 <https://doi.org/10.1371/journal.pone.0238468>

605 Ross, F. (2020). A Perspective on the Application of Kapferer's Brand Identity Prism in the Branding  
606 Process of Hearing Aid Retail Companies. *Journal of Management and Marketing Review*,  
607 5(3), 141 – 146 . Retrieved May 31, 2023, from  
608 [http://gatrenterprise.com/GATRJournals/JMMR/pdf\\_files/JMMRVol5%283%292020/2.Floria](http://gatrenterprise.com/GATRJournals/JMMR/pdf_files/JMMRVol5%283%292020/2.Florian%20Ross-Edited.pdf)  
609 [n%20Ross-Edited.pdf](http://gatrenterprise.com/GATRJournals/JMMR/pdf_files/JMMRVol5%283%292020/2.Florian%20Ross-Edited.pdf)

610 Sheffield, S. W., Jacobs, M., & Ellis Jr., C. (2022). Considerations for the Over-the-Counter Hearing Aid  
611 Delivery Model. *Perspectives of the ASHA Special Interest Groups*, 7(6), 1802–1805. Retrieved  
612 from [https://doi.org/10.1044/2022\\_PERSP-22-00058](https://doi.org/10.1044/2022_PERSP-22-00058)

613 Solheim, J., Gay, C., & Hickson, L. (2017). Older adults' experiences and issues with hearing aids in the  
614 first six months after hearing aid fitting. *International Journal of Audiology*, 57(1), 31-39.  
615 doi:<https://doi.org/10.1080/14992027.2017.1380849>

616 Taylor, B. (2016). *20Q: Interventional Audiology - Changing the Way We Deliver Care*. Retrieved May  
617 17, 2022, from Audiology Online: [https://www.audiologyonline.com/articles/20q-](https://www.audiologyonline.com/articles/20q-interventional-audiology-17080?_ga=2.97239583.168148_1)  
618 [interventional-audiology-17080?\\_ga=2.97239583.168148\\_1](https://www.audiologyonline.com/articles/20q-interventional-audiology-17080?_ga=2.97239583.168148_1)

619 Taylor, B., & Weinstein, B. (2015). *Moving from Product-Centered to Patient-Centric Care: Expanding*  
620 *Treatment Options Using Decision Aids*. Retrieved from Audiology Online:  
621 <https://www.audiologyonline.com/articles/moving-from-product-centered-to-14473>

622 The Food and Drug Administration. (2023). *Hearing Aids*. Retrieved January 16, 2023, from US Food  
623 and Drug Administration: [https://www.fda.gov/medical-devices/consumer-](https://www.fda.gov/medical-devices/consumer-products/hearing-aids)  
624 [products/hearing-aids](https://www.fda.gov/medical-devices/consumer-products/hearing-aids)

625 The National Institute on Deafness and Other Communication Disorders (NIDCD). (2021). *Quick*  
626 *Statistics About Hearing*. Retrieved February 13, 2022, from The National Institute on  
627 Deafness and Other Communication Disorders:  
628 <https://www.nidcd.nih.gov/health/statistics/quick-statistics-hearing#9>

629 Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research  
630 (COREQ): a 32-item checklist for interviews and focus groups. *International Journal for*  
631 *Quality in Health Care*, 19(6), 349–357.

632 U.S. Food and Drug Administration. (2021). *Hearing Aids and Personal Sound Amplification Products:*  
633 *What to Know*. Retrieved August 11, 2022, from U.S. Food and Drug Administration:  
634 [https://www.fda.gov/consumers/consumer-updates/hearing-aids-and-personal-sound-](https://www.fda.gov/consumers/consumer-updates/hearing-aids-and-personal-sound-amplification-products-what-know)  
635 [amplification-products-what-know](https://www.fda.gov/consumers/consumer-updates/hearing-aids-and-personal-sound-amplification-products-what-know)

636 Vercammen, C., Oosthuizen, I., Manchaiah, V., Ratinaud, P., Launer, S., & Swanepoel, D. (2023). Real-  
637 life and real-time hearing aid experiences: Insights from self-initiated ecological momentary  
638 assessments and natural language analysis. *Frontiers in Digital Health*, 5. doi:  
639 <https://doi.org/10.3389/fdgth.2023.1104308>

640 World Health Organisation (WHO). (2021). *Deafness and hearing loss*. Retrieved February 13, 2022,  
641 from World Health Organisation: [https://www.who.int/news-room/fact-](https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss)  
642 [sheets/detail/deafness-and-hearing-loss](https://www.who.int/news-room/fact-sheets/detail/deafness-and-hearing-loss)

643

644

645

646

647

648

649

650

## 651 TABLES

652 Table 1. Domain 1 - Hearing Aid Feature Suggestions (n= 628 participants)

Category	Sub-category	Meaning unit examples (participant ID, age in years, gender)
<b>Physical appearance and fit (161)</b>	Less visible (77)	<i>"As small as possible, it is best to make invisible" (P468, 25, female)</i>
	Improve comfort (48)	<i>"The area between my ear and my head becomes sore, raw. The aids cause my ears to itch" (P312, 63, female)</i>
	More secure fitting (22)	<i>"Make the design more secure in the ear so they don't fall out" (P687, 75, male)</i>
	More colours and aesthetic options (11)	<i>"I've always wanted one that looks good" (P396, 33, male)</i>
	More visible (3)	<i>"I can see the 'shame' being replaced by 'this is cool' to enabling hearing devices to be worn, colourful too." (P354, 72, female)</i>
<b>General features (143)</b>	Waterproof (40)	<i>"I wish they could be made water-resistant/waterproof the way smartwatches and fitness bands are made." (P630, 74, female)</i>
	Improve ease of use (32)	<i>"Hearing aid battery drawers need to be easier to open." (P127,61, female)</i>
	More system design improvements (24)	<i>"Keep bolstering their capabilities to monitor health - as a solo senior I'll need as much support as possible to remain independent." (P460, 68, female)</i>
	Less maintenance (12)	<i>"If cleaning them could be made easier, I would like that." (P31, 74, male)</i>
	More technological advances (11)	<i>"Electronic processing development should continue." (P304, 85, male)</i>
	Improve durability (10)	<i>"They need to have a longer lifespan." (P295, 70, male)</i>
	Include telecoil (8)	<i>"I'm VERY upset when I learn that T-coils aren't going to be included in various hearing aid models. I can't do that WITHOUT T-coils." (364, 76, female)</i>
	Include tinnitus masking (6)	<i>"Tinnitus improvements would definitely help me." (P260, 76, male)</i>
<b>Streaming (133)</b>	Improve connectivity issues (106)	<i>"All hearing aids in today's day and age really should have Bluetooth connectivity without the need for a necklace or other type of adapter" (P30, 44, female)</i>
	Ability to connect to more than one device (17)	<i>"I can only connect my aids to one phone via Bluetooth- so I chose my work cell phone. That means I can't talk to people from home, socially, or for personal reasons." (P311, 59, male)</i>
	More Android and iOS compatibility (10)	<i>"I feel all hearing aids should be compatible with all cell phones not just iPhones for example." (P455, 55, female)</i>
<b>Battery functionality (103)</b>	Prefer rechargeability (50)	<i>"I will also ONLY purchase rechargeable aids." (P79, 77, male)</i>
	Improve battery life (38)	<i>"The biggest issue, truly, is battery life." (P73, 54, female)</i>
	Improve charger options (5)	<i>"A charging case that had a battery INSIDE so that I could charge them on the go." (P437, 77, male)</i>

	Prefer rechargeability with disposable or spare batteries (4)	<i>"Even for traveling just for a weekend good to know if you had a problem with your charger; you had batteries as a backup" (P333, 71, female)</i>
	Improve access to batteries (4)	<i>"The chargeable hearing aids eventually will have to have the batteries replaced and some brands can't have this done in the doctor's office!" (P428, 74, male)</i>
	Prefer disposable batteries (2)	<i>"Keep offering aids with replaceable batteries rather than going rechargeable. I've heard too many stories of people not getting a successful charge" (P106, 64, male)</i>
<b>User-centric App (47)</b>	Improve feature range (21)	<i>"Quality of the hearing aid apps I've used is shockingly marginal. I would like much finer control over such things as volume and filter settings." (P98, 75, male)</i>
	Improve connectivity and interface (18)	<i>"My hearing aid app is basically useless. It doesn't allow me to properly adjust the volume, pitch, and tone." (P202, 69, female)</i>
	Improve usability (8)	<i>"The phone app is hard to understand. Especially with older people" (P265, 59, male)</i>
<b>Adjustments (40)</b>	More self-adjustment options (22)	<i>"Give wearers more ability to fine tune their own hearing aids without the need to always go to an audiologist." (P150, 66, male)</i>
	More remote adjustments and programming (11)	<i>"Requiring you to go back to the person you bought it from - which could be thousands of miles away after you move is horrible." (P285, 82, male)</i>
	More succinct adjustments (7)	<i>"The ability for the Audiologist to adjust each frequency independently without affecting the frequency right next to it!" (P272, 65, male)</i>
<b>Accessories (8)</b>	Wider range (6)	<i>"More gizmos like the Roger on and the Resound Multi Mic. These are game changers for me." (P95, 47, female)</i>
	More improvements (2)	<i>"Probably my major complaint is with the remote, the remotes need to be improved for Oticon anyway." (P270, 78, female)</i>

**Table 2. Domain 2 - Hearing Aid Sound Quality Suggestions (n= 628 participants)**

<b>Category</b>	<b>Sub-category</b>	<b>Meaning unit examples (participant ID, age in years, gender)</b>
<b>Sound perception (143)</b>	Improve sound recognition and clarity (70)	<i>"I would like to be able to better understand actual words spoken - not just the volume - particularly when watching a movie or TV program. Sound can be muddled." (P48, 73, female)</i>
	More natural sound (17)	<i>"A hearing aid that would be much like natural hearing without all the adjustments rather than fancy microphones." (P168, 62, female)</i>
	Improve severe-profound hearing loss options (12)	<i>"Platform rollouts for profound, at launch, not 2-3 years later, I know the market and demographics play to that, but always annoys me when profound get last dibs." (P193, 40, male)</i>
	Improve music perception (12)	<i>"Most hearing aids are not designed to replicate music accurately. The music ear buds that are evolving into hearing aids are a good direction." (P209, 64, male)</i>
	Improve television, phone and media perception (11)	<i>"And tv commercials are the worst...everything is in one volume...LOUD. You can't hear the speaker because the music drowns them out! (P339, 84, female)</i>
	Improve directionality and localisation (10)	<i>"Hearing aids are still limited directionally - i.e., need to face people to hear, cannot hear as well when people are behind me, sit next to me, lower their heads, etc." (P38, 77, female)</i>
	Eliminate feedback (8)	<i>"The squeaking drives me so insane I just want to throw the thing on the floor and stamp on it!!" (P226, 83, female)</i>
	Improve CROS HA options (3)	<i>"My question is: why can't the transmitter side of the CROS system also contain the ability to cancel out the irritating frequencies and amplify the frequencies that are mostly gone to give me some hearing boost in my bad ear, along with transmitting to the other ear?" (P281, 72, male)</i>
<b>Difficult situations (139)</b>	Improve noise reduction (57)	<i>"I can't believe with the technology available today that a hearing aid can't be design to work better in noisy place" (P384, 76, male)</i>
	Improve speech in noise perception (40)	<i>"I would like hearing aids to emphasize the voices close to me...not the whole restaurant. Why can't I introduce the aids to the voices at the table and hear those folks?" (P17, 68, female)</i>
	Improve adaptation to environment (17)	<i>"I would like them to adapt automatically or naturally to noisy restaurants or events" (P48, 73, female)</i>
	Improve real world performance (13)	<i>"Fitting in a business office does not provide an accurate measure for a person's life experiences. In office fitting settings, a recording of different voices at different sound levels (and background noises) would be very helpful for making adjustments. Just speaking to the fitter is not that helpful." (P336, 75, female)</i>
	Eliminate wind noise (7)	<i>"Get rid of wind noise. I have seen a lot of advertising over the years that states a significant reduction in wind noise...to my thinking it's false advertising" (P75, 83, male)</i>
	Improve hearing from a distance (5)	<i>"They should have a close and distant focus mode, that I can control manually, so I can hear from farther away when I want to." (P294, 59, female)</i>

**Table 3. Domain 3 - Hearing Aid Service-Delivery Suggestions (n= 628 participants)**

<b>Category</b>	<b>Sub-category</b>	<b>Meaning unit examples (participant ID, age in years, gender)</b>
<b>Cost (193)</b>	Reduce cost for devices and services (139)	<i>"The cost for so many is prohibitive." (P158, 79, female)</i>
	Enable insurance and corporate funding (32)	<i>"I think that should be a priority to get insurance companies to cover/assistance in hearing aids. Hearing NEEDS to be categorized as a DISABILITY, as it is a DISABILITY." (P268, 68, female)</i>
	Reduce cost of high-tech features (13)	<i>"There are many options like background noise, volume, directionality etc but each adds a big cost to final product and have to make choices." (P71, 74, male)</i>
	Reduce cost of repairs, guarantees and upgrades (9)	<i>"If they need repair don't make it so expensive" (P90, 67, male)</i>
<b>Audiology services (95)</b>	Access to reliable information (25)	<i>"The industry is plagued by the "100th innovation that you don't really need but we are going to convince you that you need it" mentality. This interferes with good information being easily available to solve a social connectedness problem for people." (P326, 64, male)</i>
	Improve audiologist competency (20)	<i>"I feel that when I go to have my hearing aids adjusted that the provider isn't really listening to what I am complaining about (or doesn't know what to do to help me). They seem to want to adjust the hearing aids to a formula (this was especially true at a clinic that didn't normally work on Phonak)." (P47, 80, male)</i>
	Prefer audiologist support (16)	<i>"I think it is very important to go to a real audiologist and get a good hearing test before fitting a hearing aid." (P304, 85, male)</i>
	Improve accessibility of devices and services (13)	<i>"Easier access at retail locations or online" (P26, 57, male)</i>
	Improve credibility and transparency (10)	<i>"More transparency on what you are getting for dollars paid." (P89, 73, male)</i>
	Provide trial before purchase (6)	<i>"There should be at least a 3-month free trial available. Short-wearing trials are inadequate to assess how the aids are helping or not." (P336, 75, female)</i>
	Increase public awareness (5)	<i>"I think that awareness of hearing loss and the impact on social interactions, quality of life needs to be improved." (P199, 62, male)</i>
<b>General satisfaction (90)</b>	Satisfied with technology (86)	<i>"Just between my first set of hearing aids and my second set five years later, I have seen a leap in technological advances that give me great hope for the future." (P24, 64, male)</i>

---

Dissatisfied with technology (4)

*“it’s kind of unbelievable I pay \$6500 and still can’t hear very well in many situations. I have heard better using a Personal Listening Device like Pocket Talker, which is kind of a joke.” (P433, 23, male)*

---

657



658

659 **SCRIPT END**