

1 **Early intervention in audiology: Exploring the current status from a developing country**
2 **context.**

3
4 **ABSTRACT**

5 **Aims:** ~~Analysis~~ **Analysis** of the current audiological management protocols for children
6 with hearing impairment in South Africa's Gauteng state hospitals was investigated in this
7 study.

8 **Study design and methods:** A retrospective record review was conducted, with 70
9 files/medical records of paediatric patients between the ages of birth and ~~3-three~~ years ~~were~~
10 ~~reviewed of participants. These records came~~ from ~~3-three~~ state hospitals' audiology clinics
11 ~~where full audiological and otological services were available.~~

12 **Results:** ~~The results~~ **Findings** of this study ~~revealed concerning trends. Firstly, findings~~
13 indicated that on average children were identified with a hearing loss at 23.65 months.

14 ~~Secondly, 71~~ they received amplification 7.11 months after diagnosis and were ~~only~~
15 introduced into aural rehabilitation at the average age of 31.2 months. ~~However,~~ 81% of
16 children received appropriate audiological tests; ~~with~~ 85.7 % of children who were identified
17 with a hearing loss received ~~inged~~ amplification. ~~and a~~ All children identified with a bilateral
18 hearing loss ~~in the current sample~~ were aided bilaterally. ~~As far as communication~~
19 ~~development was concerned,~~ 48.57 % of the children identified with a hearing loss received
20 ~~the~~ auditory verbal therapy approach, ~~with~~ 18.57 % receiving ~~inged~~ sign language as a means of
21 communication, ~~while~~ 11.43% received a total communication approach. ~~A significant~~
22 ~~number (14.29 %)~~ were not receiving aural rehabilitation therapy.

23 **Conclusion:** Findings raise important implications for the success of early hearing detection
24 and intervention (EHDI) initiatives in South Africa. ~~Improved and concerted efforts in the form~~
25 ~~of systematic planning and implementation of EHDI protocols are required.~~

26
27 *Key words: Audiological management, early intervention, paediatric, state hospitals, South Africa*

Formatted: Font: (Default) Arial, 11 pt

Formatted: Font: (Default) Arial, 11 pt, Bold, Font color: Yellow

Formatted: Font: (Default) Arial, 11 pt

Formatted: Font: (Default) Arial, 11 pt

28

29

30

31

32

33

34 1. INTRODUCTION

35 Early intervention is defined as intervention practices for children from the ages of birth until
36 ~~three~~ years of age [1]. In the 2007 position statement by the Health Profession Council of South
37 Africa (HPCSA) it is stated that: "Early hearing detection and intervention programmes are
38 recommended to identify, diagnose and treat newborns and infants with a disabling hearing loss as
39 early as possible to ensure that optimum, cost effective solutions, that enable persons to
40 communicate effectively, allowing them to develop to their maximum potential, and thereby to secure
41 their full participation in and contribution to, society and the country's economy" [2].

42 Studies have indicated that undetected hearing loss can lead to irreversible ~~speech~~, language,
43 ~~speech~~ and cognitive delays [3]. It is therefore vital for early hearing detection and intervention (EHDI)
44 to take place ~~before-prior to~~ 6 months ~~of age~~ so that the child is able to maintain age appropriate
45 development with regards to language skills [3]. The most critical time for development of the brain's
46 hearing centres is during the first few months of life [4]. Failure to detect a hearing loss ~~early~~ may
47 result in a profound delay of 2-4 years with regards to development of language abilities and skills [3].-
48 Hearing loss is the most frequent occurring birth defect, although not life threatening, failure to
49 intervene in time will severely affect one's quality of life [5].

50 Universal Newborn Hearing Screening (UNHS) programmes have proven to be beneficial as
51 they allow for early detection of a hearing loss in children and subsequent intervention leads to
52 linguistic, speech and cognitive development that is comparable to their normally hearing peers [6].
53 Because of this benefit, early detection and intervention for infants with hearing loss ~~is has becoming~~
54 become standard practice in developed countries [7], such as the United States and the United
55 Kingdom. In countries such as America and the United Kingdom, ~~UNHS programmes have been~~
56 ~~recently implemented [4]~~. ~~Up~~ until 1990 children born with a hearing loss would have only been
57 identified by the ages of 2.5 to 3 years old [4]. However, with the implementation of EHDI services
58 and UNHS, the average age of identification and confirmation of hearing impairment in these
59 ~~countries developed countries~~ has decreased to 2-3 months [4]. The situation is different for
60 developing countries where the issue of costs and burden of disease priorities are still challenging. A
61 bulk of the health expenditure is usually spent on curative measure as well as treatment of life-
62 threatening conditions; with rehabilitation and preventative care arguably receiving lesser financial
63 attention – although cost-effectiveness of such programmes have been well established. National
64 priorities in developing countries will often be geared towards higher profile issues and cost-
65 effectiveness arguments in such severely resource-constrained settings can therefore be ineffective.
66 Arguably, the achievement of EHDI goals in developing countries depends on a strong political will in
67 the form of allocation of funds committed to EHDI, and this is often not the case in many developing
68 countries; South Africa included. ~~The results of this study provides' information regarding the age of~~
69 ~~identification and confirmation of hearing loss in the South African context.~~

70 ~~It is Un~~ unfortunately that widespread implementing implementation EHDI programmes has not
71 carried over to the developing world which is home to two thirds of the world's children with hearing
72 loss [8]. In places such as India, China and South Africa where UNHS has not been implemented,
73 hearing loss is only often detected as a consequence of parental concerns regarding delays in speech
74 and language development [9]. In developing such countries the detection period usually only begins
75 occurs from two years of age and extends well into the adolescent years [9].

76 A study by Swanepoel and Storbeck[10],-regarding the prevalence of hearing loss in South
77 Africa, within both the private and public health care settings. revealed that, in the private sector,
78 which services 15% of the total population, the prevalence of hearing loss is 3 in every 1000 births,

79 which translates to an annual rate of 496 and a daily rate 1.5 of people born with a hearing loss [10].
80 In the public sector which ~~services up services upto~~ 85% of the population, the prevalence of hearing
81 loss is 6 in every 1000 births which is an annual rate of 5620 and a daily rate of 15.5 per day of
82 people born with a hearing loss [10].

83 With such a high prevalence of hearing loss in the public health sector in South Africa, there
84 ~~currently is a dearth of published is limited~~ research into the early intervention services provided ~~in~~
85 ~~to~~ this population [11]. ~~Limited human resources in the form of audiologists employed in the public~~
86 ~~health sector when compared to those in private practice possibly has a role. This may be due to~~
87 ~~There is a reported~~ low audiologist-to-patient-ratio ~~as well as and~~ heavy clinical service load,
88 particularly in the public sector [11]. The majority of audiologists work in the private health care sector
89 which services only the minority of the population ~~{[11]; hence attention to public healthcare EHDl~~
90 ~~research issues is not a priority.~~

91 According to Storbeck and Pitman [3], ~~for comprehensive EHDl program implementation;~~ there
92 are three stages ~~that need to be included to EHDl.~~ The first stage is that of identification, ~~which~~
93 ~~comprising comprises~~ of screening ~~of for~~ hearing loss. The second stage is that of referral ~~to~~
94 ~~for~~ diagnostic tests [3] ~~in order to confirm, describe and categorize the hearing impairment. This~~
95 ~~involves the confirmation of a hearing loss [3].~~ The final stage of ~~EHDl hearing detection and~~
96 ~~intervention~~ involves intervention services [3]. The current study therefore aimed to explore the
97 audiological management of paediatric patients through all ~~three these~~ stages ~~outlined by Storbeck~~
98 ~~and Pitman [3].~~

99 ~~Most infants with hearing loss and their families will should~~ enrol in aural rehabilitation; ~~at 3~~
100 ~~years of age [12]. Aural rehabilitation is which is~~ intervention ~~aimed at geared towards~~ minimising and
101 alleviating the communication difficulties associated with a hearing loss [12]. There are a variety of
102 approaches to long-term intervention ~~for these infants~~ [13]. Most programmes and approaches aim to
103 equip the child's parents with the skills and tools needed to facilitate the child's communication
104 abilities. Most of the assistance focuses on language development, which often includes auditory
105 stimulation [13]. ~~For infants and families to benefit from such programs, adherence to the treatment~~

106 ~~plan is vital; and that includes follow-up. Results of the current study provided a description of the~~
107 ~~communication/intervention approaches being offered in Gauteng Hospitals.~~

108 Follow-up ~~has been reported as is~~ the most difficult ~~part~~ aspect of an EHDl programme, and it
109 ~~has been advocated that is vital that~~ any obstacles to follow-up be identified [14] ~~and managed~~
110 ~~timeously~~. Audiologists and other health care professionals can help ensure follow-up return rates by
111 providing good and relevant communication ~~with to~~ caregivers [14]. Communication with caregivers
112 can include; education and counselling regarding the risk factors for hearing loss, the importance of
113 early identification, the significance of follow-up visits, and the implications of undetected hearing loss
114 [14].

115 Variables such as age of diagnosis, nature of intervention and rehabilitation have not yet been
116 comprehensively examined ~~within the in~~ South African context, where the nature of early intervention
117 is affected by the country being classified as having both ~~a~~ developed and ~~a~~ developing country
118 ~~qualities~~ [14]. While extensive literature is available on the practices and models of early
119 intervention in developed countries, little information is available in developing countries where
120 policies and practices ~~are~~ arguably largely inadequate [14]; hence the current study.

121 ~~The primary aim of this~~ the current study was to investigate the current audiological
122 management protocols for the paediatric population in Johannesburg, Gauteng; with the following
123 being the secondary objectives:-

124 Secondary Objectives

- 125 • To establish the age of identification of children with hearing impairment
- 126 • To determine the audiological assessment tools utilised with this population
- 127 • To determine if amplification is provided in children identified with a hearing impairment
- 128 • To establish the time period between diagnosis of hearing loss and provision of amplification
- 129 • To determine the type of amplification provided
- 130 • To determine if bilateral amplification was provided where indicated.
- 131 • To determine what mode of communication is being utilised in therapy with this population.

132

133

134

135 2. METHODOLOGY

136 **Primary Aim**

137 ~~The primary aim of this study was to investigate the current audiological management protocols~~
138 ~~for the paediatric population in Johannesburg, Gauteng.~~

139 **Secondary Objectives**

- 140 • ~~To establish the age of identification of children hearing impairment~~
- 141 • ~~To determine the audiological assessment tools utilised with this population~~
- 142 • ~~To determine if amplification is provided in children identified with a hearing impairment~~
- 143 • ~~To establish the time period between diagnosis of hearing loss and provision of amplification~~
- 144 • ~~To determine the type of amplification provided~~
- 145 • ~~To determine if bilateral amplification was provided where indicated.~~
- 146 • ~~To determine what mode of communication is being utilised.~~

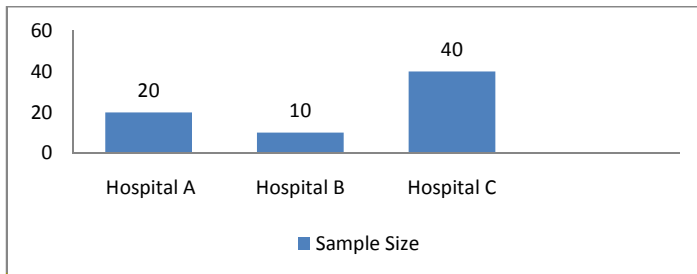
147 **Design of the Study**

148 Following ethical clearance from the University's Medical Ethics Committee, This study
149 adopted a retrospective record review. A retrospective study is designed to examine data that is
150 already on file; therefore, the researcher makes observations and can provide descriptive statistics
151 from this data [15]. A spread sheet depicting data directly related to the specific objectives of the
152 study was formulated and used to capture the data from the files.

153 **Participants**Files reviewed

154 | **Description of participants files:**

155 | a) Sample size



Formatted: Font: (Default) Arial, 10 pt, Bold

156 |

157 | **FIGURE 1: Depiction of Number of Participants (N=70)**

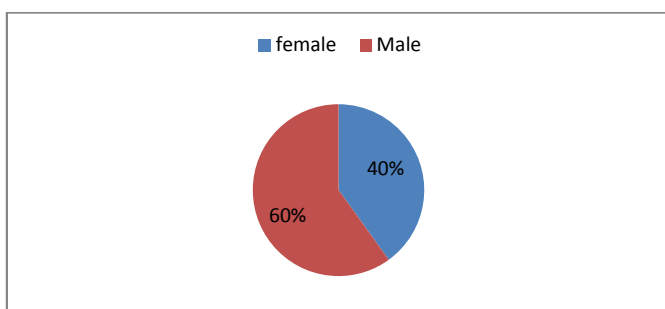
158 |

159 | The Sample Size consisted of 70 files, with 20 files from Hospital A, 10 files from Hospital B and 40
160 | files from hospital C as depicted in figure 1. All three hospitals have fully resourced audiology clinics. It
161 | is important to note that only audiology files of patients who had been cleared from the Ear, Nose and
162 | Throat Specialists in terms of absence of middle ear disease were included in the sample.

163 |

164 | b) Gender:

165 |



Formatted: Font: (Default) Arial, 10 pt, Bold

166 |

167 **FIGURE 2: Gender breakdown of the sample (N=70)**

168

169 The gender breakdown of the participant files reviewed comprised of 60% males and 40% females as
170 depicted in Figure 2.

171

172 c) Types of hearing loss in the sample:

173 Standard audiology protocol dictates that all patients presenting with abnormal auditory function,
174 findings be categorized into type of hearing loss; symmetry of the hearing loss, as well as severity or
175 degree of the loss. The hearing losses are classified into the three well-documented types of hearing
176 losses (conductive - CHL; mixed - MHL; and sensorineural - SNHL). Symmetry of hearing loss is
177 examined where the audiologist established whether the hearing loss was unilateral or bilateral, and
178 whether it was symmetrical or asymmetrical. The degree of hearing loss is determined using the
179 classification of Magnitude of Hearing Impairment. This classification system proposes that impaired
180 hearing function begins at an average hearing level of 25 dB HL, and is categorized as seen in Table
181 1.

Formatted: Font: (Default) Arial, 10 pt

Formatted: Line spacing: Double

182 **Table 1: System of classification of hearing loss in terms of degree of loss used in the current**
183 **study**

Formatted: Font: (Default) Arial

Average Hearing Level dB	Description
< 26 dB	Normal range
26dB – 40 dB	Mild hearing loss
41dB – 55 dB	Moderate hearing loss
56dB – 70 dB	Moderately severe hearing loss
71dB – 90 dB	Severe hearing loss
>91 dB	Profound hearing loss

Formatted: Font: (Default) Arial

Formatted: Font: (Default) Arial

Formatted: Font: (Default) Arial

Formatted: Font: (Default) Arial

Formatted: Font: (Default) Arial

Formatted: Font: (Default) Arial

Formatted: Font: (Default) Arial

185

186

187 Adopting the standard protocol described above, analysis of the data in the files yielded the
188 following results, as depicted in Table 2 below.

189

190

191

192 **TABLE 42: Type-Description of Hearing Loss test results in the sample (N=70)**

<u>Type-Description of hearing test results</u>	Percentage of participants
Bilateral severe to profound SNHL	29%
Bilateral profound SNHL	20%
Bilateral severe SNHL	17%
OAE bilateral fail (<u>absent OAEs bilaterally</u>)	10%
Bilateral moderate to severe SNHL	7%
Bilateral moderate SNHL	4%
Unilateral moderate to severe SNHL	3%
Unilateral severe SNHL	3%
Bilateral mild to moderate SNHL	3%
Unilateral profound SNHL	1%
OAE unilateral fail (<u>absent OAEs unilaterally</u>)	1%
Unilateral moderate SNHL	1%

193 **Key: SNHL=sensorineural hearing loss;OAE=otoacoustic emissions**

194 From Table 21 above, it is seen-evident that the types of hearing loss of the children whose
195 files were included in the current study ranged from unilateral to bilateral, mild hearing losses to
196 profound losses; with nature being only sensorineural hearing loss. Bilateral profound hearing losses
197 were the most common types of hearing loss diagnosedfound. This may have-been-be due to the fact
198 that a profound loss is easier to be-identified-identifyby-for parents and caregivers than a moderate or
199 mild hearing loss; and so in the absence of UNHS; these are the children seen for intervention. Often,

200 ~~Parents parents are bringingbring~~ their children ~~in~~ for an audiological~~examination assessment~~at this
201 ~~stage~~ because of concerns regarding delays in speech and language development.

202 .

203

204 **Sampling Procedure**

205 ~~Participants were recruited from 3 state hospitals referred to herewith as hospital A, hospital B~~
206 ~~and hospital C. The sample is comprised of 70 participant's files including both males and females.~~
207 ~~Hospital A provided 20 files for review while hospital B provided 10 files for review and Hospital C~~
208 ~~provided 40 files for review.~~

209 **Data analysis and statistical procedures**

210 This study made use of descriptive statistics. Descriptive statistics are utilized to observe
211 group differences, developmental trends or relationships among variables that can be measured by
212 the researcher [15]. "Research of this type provides an empirical picture of what was observed at one
213 time or of observed changes over a period of time, without the manipulation of independent variables
214 by the researcher" [15]. The independent variables in this study were ~~as follows~~; age, gender, type of
215 hearing loss, audiological assessments, amplification, age ~~of at~~introduction into aural rehabilitation
216 and mode of communication. ~~The data were then Ggenerated intoof~~ graphical/tabular
217 representation ~~in whichwhere~~ the values of each variable ~~is were~~plotted against the number of times it
218 occurred; ~~and this~~ allow~~eds~~ the researcher to provide and organise scores and observations ~~into~~ a
219 summarised fashion [16].

220 **3. RESULTS AND DISCUSSION**

221 **Age of identification of hearing loss**

222 ~~In addressing the specific aim of establishing the age of identification of children with hearing~~
223 ~~impairment, results indicated significantly delayed age of identification, are depicted in Table 2.~~

Formatted: Font: (Default) Arial, 10 pt

Formatted: Line spacing: Double

224

225

226

TABLE 2

Age of Diagnosis of hearing loss in Gauteng State Hospitals

	Average	Median	Mode	Range
Age of Diagnosis	23.65 Months	26 Months	36 Months	0.5 Months- 39 Months

227

228

229

230

231

232

233

234

235

236

237

238

239

240

241

242

243

244

~~The results~~Current findings indicated the children's ages of hearing loss identification ranged from 2 weeks to 3 years 3 months, with a mean age of identification being 23.65 months, the median age was 26 months and the mode age was 36 months. The HPCSA position statement states that children should be identified by the age of 3 months [2]; a recommendation which was not realised in the data from the current study where children were being identified much later than 3 months of age. ~~Previous findings have found~~ Literature has advocated that the best way to identify hearing loss as early as possible is via UNHS [9]; ~~However however,~~ this is not the common practice in the Gauteng state hospitals, or across the country. ~~Instead, T~~ the current study findings suggested that hearing loss was being mainly detected as a result of parental concerns as opposed to via UNHS; and consequently the detection period may be from 2 years of age until as late as adolescents [9]. Current findings not only highlight the importance of UNHS; but also raise an implication for improved parental awareness programs where parents are educated about signs and symptoms of hearing impairment much earlier than the age of two years; awareness about risk factors to hearing loss; as well as the importance of observing and facilitating pre-linguistic development. This supports current findings and raises implications for implementing early hearing detection services for all children born, and not just those children deemed at risk.

245

246

247

248

249

250

251

Swanepoel [17], states that there are an insufficient numbers of audiologists in the country; and that these audiologists are unequally distributed between the private and public sector, with the public sector being significantly under-staffed for the population size they serviceserve. The low audiologist to patient ratio can possibly be the biggest challenge in the provision of adequate audiological services in South Africa [17]; and so there is heavy reliance on referrals from the doctors, nurses, and other allied medical disciplines. This therefore has implications for improved multi and inter-disciplinary team work; with an increased need for the audiologist to conduct awareness

252 | ~~campaigns within the teams. Children who are not referred for early audiological services, fail to be~~
253 | ~~diagnosed early, therefore highlighting the importance of educating doctors as well as allied health~~
254 | ~~professions and nurses regarding hearing loss in order for appropriate referrals to be made [17].~~
255 | Failure to detect a hearing loss may result in significant consequences for the child's speech and
256 | language acquisition, academic performance as well as social and emotional wellbeing [1]; ~~and so the~~
257 | ~~cost-effectiveness of such campaigns is positive. If appropriate referral and early identification of~~
258 | ~~hearing loss does not occur then early rehabilitation and management cannot be established.~~
259 |

260 | **Audiological evaluations**

261 | In addressing the second aim of establishing the audiological evaluation of children with
262 | hearing impairment; ~~current~~ results indicated that 81% of children received ~~the~~ appropriate
263 | ~~comprehensive~~ audiological ~~intervention~~ evaluations. Results were further analysed and 88% of the
264 | children received an otoscopic examination, 81% middle ear tests such as tympanometry, 68%
265 | received subjective testing ~~in the form of visual reinforcement and/or behavioural observation~~
266 | ~~audiometry~~, 82% received an OAE ~~measure~~ and 78% of the children underwent an ~~auditory~~
267 | ~~brainstem response (ABR) assessment~~. From the current findings, it was clear that the majority of
268 | participants (approximately 81%) underwent appropriate and ~~accurate~~ ~~comprehensive~~ audiological
269 | evaluations that included both ~~behavioral~~ ~~behavioural~~ and objective measures. These findings are
270 | consistent with the JCIH recommended test batteries for infants. ~~These positive findings are in the~~
271 | ~~context where R~~ research has ~~shown that shown that~~ audiology services within the South African
272 | context are significantly influenced by equipment constraints. In the public healthcare sector, progress
273 | ~~has been hampered is due to by~~ limited availability of equipment, ~~use of outdated equipment;~~ and
274 | ~~constant challenge with funding to un~~ repaired ~~and/or calibrate~~ equipment [17].
275 |

276 | **Amplification**

277 | ~~The third aim of the current study was to identify whether children diagnosed with hearing~~
278 | ~~impairment~~ were provided with amplification. From the data collected, 60 out of 70 (85.71%) children
279 | were fitted with amplification. Of the 10 that were not fitted, 8 had not returned to the audiology clinics
280 | for follow up after they had been diagnosed with a hearing loss, 1 was awaiting results from an ABR
281 | and 1 was booked for a recheck as a clear and consistent diagnosis had not ~~yet~~ been

Formatted: Font: (Default) Arial, 10 pt

Formatted: Font: (Default) Arial, 10 pt

282 made. Considering the costs associated with amplification and limited resources under which state
 283 hospitals function, the fact that a large majority of the participants were aided is a significantly positive
 284 finding. Evidence suggests that Previous findings have identified that the provision of amplification as
 285 soon as possible after a child is identified with a hearing loss, is of crucial importance as a lack of
 286 auditory stimulation will have an effect on the development of the child's speech and language skills
 287 [18]. Evidence further illustrates that if children with hearing loss are provided with amplification
 288 between 6- 12 months of age, their it will allow them to develop age appropriate spoken language and
 289 cognitive skills become comparable to those of their normally hearing peers [18]. Current findings are
 290 very positive for the South African context specifically within the government healthcare sector,
 291 indicating that once identified with a hearing loss, at least 85% of children received amplification; and
 292 this figure would be higher if challenges such as follow-up; and parental awareness of hearing
 293 impairment and its effects were addressed. The remaining 10 children did not receive amplification,
 294 because they did not return for follow up services. Lack of awareness with regard to hearing loss, and
 295 the impact that a hearing loss can have on the child's development has been identified as contributing
 296 factors towards failure to return for follow up [17]. It is believed that this finding might be different if
 297 UNHS was being implemented and there were possibly greater numbers of children identified
 298 (including those with mild and/or moderate hearing loss); as this would require greater budgetary
 299 consideration.

300

301 **Type of amplification**

302 The next aim of this study was to examine the type of amplification being provided to children
 303 who are diagnosed with hearing loss in the Gauteng state hospitals.

304

305

306

307 **TABLE 33: Types of Amplification Provided provided in the current sample**

Type of amplification	Number of participants	Percent
-----------------------	------------------------	---------

Aids	Behind-the ear Hearing	52	86.66%
aids	Bone Anchored Hearing	3	5 %
	Cochlear Implants	3	5%
	Referrals not in district *	2	3.33%

308

309

310

311

312

313

314

315

316

317

318

319

320

321

322

323

324

325

326

327

328

329

330

331

332

333

334

The results showed that 86.66% ~~children of the sample~~ received behind-the-ear hearing aids, 5% received Bone Anchored Hearing Aids (BAHA), 5% received cochlear implants, and 3.33 % were referred ~~elsewhere~~ because they were not ~~from~~ within the ~~diagnosing~~ hospital ~~district~~. ~~Findings district of the current study reveal that 86.66% of children who received amplification received behind-the ear hearing aids. Published evidence Previous reports have stated indicates~~ that the public health care system in South Africa provides behind-the ear hearing aids free of charge to children under the age of 6 years ~~old~~ [14]. This practice therefore explains the current findings as to why behind-the ear hearing aids were the most popular type of amplification in the current sample. Bone Anchored Hearing Aids (BAHA) were supplied to those children with ~~additional~~ outer ~~and middle~~ ear pathologies. ~~5%~~ Five percent of participants in the current study were fitted with cochlear implants. ~~The fact that only 5% of the sample were fitted with cochlear implants This~~ was not a surprising finding for this context when one considers the costs involved with cochlear implantation. The expense of ~~the~~ cochlear implants and the high costs associated with the follow up and therapy are possible factors which contributed to the low percentage of children fitted with cochlear implants in Gauteng state hospitals [14]. ~~The current authors postulate that the numbers of cochlear implantees is not likely to increase in the near future if UNHS is universally implemented in the country. This is based on the belief that if more children are identified; ethical practice would dictate that they receive amplification; and budgetary constraints would not allow for as wide a coverage should cochlear implants be standard. This of course would not be true if an increased and dedicated budget is allocated to EHDl programmes in the country.~~

Timing of amplification

In addressing the specific aim of the time lapse between ~~identification and~~ amplification ~~and identification~~, (Table 4) it was found that the period ranged from 2 weeks to 3 years with a mean of 7.11 months. ~~The median was 4 months; and the mode was 3 months.~~

335
336
337
338
339
340

Table 4: The Timing of Amplification in the current sample

	Average	Median	Mode	Range
Timing of Amplification	7.11 Months	4 Months	3 Months	0.5 months – 36 months

341
342
343
344
345
346
347
348
349
350
351
352
353
354

These findings are inconsistent with the study conducted by Swanepoel [10] in urban South Africa, ~~that which revealed that~~ the average amount of time between diagnosis and fitting was 5 months; ~~although this study was also in urban South Africa.~~ The results of the current study indicated that the average age of identification of a hearing loss is 23 months, and the average waiting period to be fitted with a hearing aid is ~~approximately 7-8 months.~~ Children only received amplification ~~around at~~ 30 months ~~of age~~ and therefore missed out on the critical periods of accessing residual hearing for language acquisition. ~~The age of amplification in the current study is significantly delayed when compared to the recommended guidelines of Previous research suggests that~~ amplification between 6 to 12 months ~~of age. This therefore puts the South African hearing impaired child at a significant disadvantage when it comes to them allows children with hearing loss to develop~~ing spoken language and cognitive skills comparable to their normal hearing peers [18].

355
356
357
358
359
360
361
362

There may be different reasons for the long waiting period for amplification ~~found in the current study.~~ In the public health care system, administrative measures are reported to often be a major factor delaying the availability and accessibility of hearing aids ~~to the hearing impaired.~~ Time delays linked to procurement processes result in the late fitting of amplification. ~~The procurement process often dictates that companies supplying hearing aids be paid before hearing aids are delivered; and this process often takes considerable time – time which~~ ~~A further factor adversely affects~~ ~~effecting efficiency is the hospital administration and the need to pay the hearing aid companies before hearing aids can be fitted~~ in provision of hearing aids timeously. ~~Furthermore,~~

363 between the public and the private health care sectors, audiologists are unequally
364 ~~distributed, distributed~~; with an insufficient number of audiologists in the public sector [17]; which has a
365 direct impact on caseloads. Busy therapist schedules in the government-public sector due to the long
366 waiting lists are another contributing factor to this delayed amplification [17] as therapists have to
367 attend to a much higher patient load and their bookings are usually exceptionally high. ~~A further~~
368 ~~factor adversely affecting efficiency is the hospital administration and the need to pay the hearing aid~~
369 ~~companies before hearing aids can be fitted~~.

371 These findings highlight the urgency for careful administrative planning that includes
372 appropriate human resource allocation as well as more efficient procurement systems in the public
373 sector. ~~audiologists and other health care professionals to ensure that good and appropriate~~
374 ~~communication with caregivers is in place so that early intervention can be achieved~~. Education and
375 ~~counselling the reasons for early identification, the importance of follow-up visits, and the implications~~
376 ~~of undetected hearing loss must be explained to the caregivers [19]~~.

378 **Unilateral versus bilateral fitting**

379 In addressing the specific aim of establishing whether bilateral or unilateral amplification was
380 provided, results indicated that all the children identified with a bilateral hearing loss were bilaterally
381 aided and all those identified with a unilateral hearing loss were unilaterally aided. This is another
382 positive finding from the current sample; in that financial constraints do not seem to be compromising
383 the clinical service for the identified children.
384 Enough evidence Research has ~~shown demonstrated~~ that children with a bilateral hearing loss will
385 benefit more from bilateral amplification ~~than~~ those who are monaurally ~~amplified~~ fitted. Binaural
386 hearing aids provide benefit such as clarity of speech ~~and as well as~~ hearing in noisy conditions. A
387 ~~b~~ Binaural fitting is said to ~~removes~~ the need for strategic positioning; and it is reported to as well as
388 supporting higher order functionalities through improvements in binaural processing [20]. In light of
389 this, the findings of the ~~is~~ current study indicate a better prognosis for the children in terms of
390 acquisition of speech and language skills during the aural habilitation process. These findings would
391 be even more positive had the age of identification and the age at amplification was lower in the
392 current sample.

393

394 **Age of at introduction into aural rehabilitation**

395 In addressing the specific aim of establishing the age of at introduction into aural rehabilitation,
396 the following results were found: the children’s ages ranged from 3 months to 5 years 3 months, with
397 an average age of 2 years 5 months. ~~The median was 32 months; and the mode being 36 months,~~
398 ~~thus indicating non-normal distribution.~~

399

400 **Table 5: Age of Introduction into Aural Rehabilitation.**

	Aver age	Median	Mode	Range
Age of introduction into aural rehabilitation	31.2 months	32 Months	36 Months	3Months –64 Months

401

402

403 These findings, are although consistent with previous findings by Swanepoel [10], where that
404 the average age of initial enrolment into an early intervention programme was 31 months; are Current
405 findings are therefore disappointing and concerning. These findings as they indicate a significantly
406 delayed point of entry to aural rehabilitation; which had a negative impact on their speech, language
407 and cognitive skills [18]. The HPCSA position paper states that children must be enrolled in an early
408 intervention programme before the age of 6 months [2]. ~~Previous findings have found that it is vital for~~
409 ~~EHDI to take place before 6 months so that the child is able to maintain age-appropriate development~~
410 ~~with regards to language skills [3]. Of course; delayed point of entry to rehabilitation is consistent with~~
411 ~~delayed identification found in the current study; and this yet again just highlights the importance of~~
412 ~~UNHS and/or targeted screening at neonatal period to ensure early identification. Current findings are~~
413 ~~therefore disappointing and concerning as they indicate a significantly delayed point of entry to aural~~
414 ~~rehabilitation; which had a negative impact on their speech, language and cognitive skills [18].~~

415

416 **Modes of Communication**

417 In addressing the specific aim of establishing the mode of communication being adopted in
418 therapy with the hearing impaired children in the public hospitals in Gauteng, results are depicted in
419 Table 46.

420

421 **Table 6: Modes of communication of Children Identified With a Hearing Loss in**
 422 **Gauteng State Hospitals**

Mode of Communication	Percentage
Auditory Verbal Therapy (AVT)	48.57%
Sign Language	18.57%
Total Communication	11.43%
No Aural Rehab	14.29%
Referrals as not in district	1.43%

430 **Table 4: Modes of communication of Children Identified with a Hearing Loss in**
 431 **Gauteng State Hospitals**

<u>Mode of Communication</u>	<u>Percentage</u>
<u>Auditory Verbal Therapy (AVT)</u>	<u>48.57 %</u>
<u>Sign Language</u>	<u>18.57 %</u>
<u>Total Communication</u>	<u>11.43%</u>
<u>No Aural Rehabilitation</u>	<u>14.29 %</u>
<u>Referrals to elsewhere as child's residence not in district</u>	<u>1.43 %</u>

- Formatted: Font: Bold
- Formatted: Centered
- Formatted Table
- Formatted: Centered
- Formatted: Centered, Indent: First line: 0.5", Line spacing: single
- Formatted: Centered
- Formatted: Centered, Indent: First line: 0.5", Line spacing: single
- Formatted: Centered, Indent: First line: 0.5", Line spacing: single
- Formatted: Centered, Indent: First line: 0.5", Line spacing: single
- Formatted: Centered
- Formatted: Centered

436 Results ~~showed-revealed~~ that 48.57% of children who receive aural rehabilitation were utilising
 437 an AVT approach ~~which allowed them to effectively communicate through speech [21]; while-~~ 18.57%
 438 were using sign language as a mode of communication ~~and this gave them access into the deaf~~
 439 ~~community [12]. A further~~ 11.43% were using ~~a the~~ total communication approach; ~~whileand-~~ 14.29% ~~of~~
 440 ~~the current sample~~ did ~~not~~ receive aural rehabilitation. ~~Finding of this study showed that in Gauteng~~
 441 ~~state hospitals 48.57% of participants utilised an AVT approach, which allowed children to effectively~~
 442 ~~communicate through speech [21]. Sign Language was utilised by 18.57 % of participants and gave~~
 443 ~~them access into the deaf community [12]. 14.29% of participants did not receiving aural~~
 444 ~~rehabilitation. Those that did not receive aural rehabilitation were again affected by F~~ failure to follow

445 up: which has been reported to limit the effectiveness of early identification efforts. Follow-up aural
446 rehabilitation appointments are also crucial ~~for the children~~ because of the possible progressive
447 nature of paediatric hearing loss [17].

448

449 **Limitations**

450 ~~There are limitations to this study. First, the data represent a relatively small percentage of~~
451 ~~the participants. Second, the sample size was unequally distributed between the three different~~
452 ~~hospitals. In addition, being that the record review approach was used; the researcher could only~~
453 ~~make use of what information was available to them. Information may have been incorrectly recorded,~~
454 ~~or important information may have not been available.~~

455

456 **Future research**

457 ~~This research study adds to the body of literature, regarding the audiological management of~~
458 ~~children identified with a hearing loss, as well as early hearing detection and intervention services~~
459 ~~available in South Africa. Although appropriate management strategies are in place, timing is of major~~
460 ~~concern with regards to early identification, hearing aid fittings as well as introduction into aural~~
461 ~~rehabilitation. It is hoped that this project will be motivation to provide early identification services in~~
462 ~~Gauteng hospitals; as well as to provide a stepping stone on further research into the long term~~
463 ~~management and follow up of children identified with a hearing loss in South Africa.~~

464

465 ~~The use of full audiological records allowed for the broad review of all audiological information~~
466 ~~pertaining to children included in this study. However, although a substantially large sample size of 70~~
467 ~~hospital files were available for review, with majority of the sample coming from one hospital. And~~
468 ~~thus the information is pertaining to the one specific hospital. Future research could look at a broader~~
469 ~~sample with more participants equally distributed.~~

470

471 ~~Future research could also benefit from doing a longitudinal study and seeing whether these~~
472 ~~children are benefiting from aural rehabilitation and whether appropriate management is being done~~
473 ~~with a long term effect. As there is little research in the field of audiological management within the~~

474 | ~~South African context, further research can be done in this area to expand the current findings and~~
475 | ~~literature.~~

476

477 | 4. **CONCLUSIONS AND RECOMMENDATIONS**

478 | This study investigated the audiological management of children who were identified with a
479 | hearing loss in the Gauteng state hospitals; in South Africa. ~~Although current findings should be~~
480 | ~~interpreted within the identified limitations in the design such as the small sample size; these findings~~
481 | ~~still have relevance and value for EHDl efforts within a developing country context.~~ The results of this
482 | study indicated that ~~early identification and intervention as internationally recognised has not yet been~~
483 | ~~achieved. There is a significant delay in the time when children are diagnosed with hearing loss;~~
484 | ~~notable lag in the period between identification and provision of amplification; with a serious delay in~~
485 | ~~enrolment into aural rehabilitation programmes.~~ on average children are identified with a hearing loss
486 | at 23.65 months and they receive amplification ~~7.11 months after diagnosis. They were introduced~~
487 | ~~into aural rehabilitation after 31.2 months. This delay is not only against internationally recommended~~
488 | ~~norms; but also This is significantly delayed~~ when compared to the Health Professions' Council of
489 | South Africa's guidelines of children being identified by 3 months and amplification being provided by
490 | 6 months of age. These results may be due to lack of parental knowledge regarding hearing loss,
491 | poor audiologist to patient ratio in the government sector as well as burden of disease priorities for
492 | both patients and healthcare providers. ~~Although identification and intervention is delayed; once~~
493 | ~~identified, the results indicate that appropriate audiological intervention is provided; and this includes~~
494 | ~~individualised aural rehabilitation programs that include collaboration with caregivers and families,~~
495 | ~~schools and communities; as well as comprehensive medical team management.~~

496

497 | ~~81% of children are receiving the appropriate audiological intervention. One of the most~~
498 | ~~important aspects of the current study that needs to be considered is the age of identification, which is~~
499 | ~~as late as 23 months. Current findings highlight the importance of This motivates for the importance~~
500 | ~~and the need for mandated structured and systematic~~ new born hearing screening programs in
501 | Gauteng hospitals which could lead to earlier identification. ~~If the age of identification is reduced;~~
502 | ~~consequent early intervention will be achieved. Success of such programs will be achieved if~~
503 | ~~challenges such as poor follow up; where many children are lost to the system and not benefiting from~~

504 the services provided, are also addressed at the same time. Current evidence highlights the need to
505 put in place appropriate follow up services to ensure that children, once identified with a hearing loss,
506 are being fitted with amplification timeously and continue to receive appropriate intervention.
507 Audiologist need to advocate for early hearing detection and intervention to mitigate for the well
508 documented effects of unidentified hearing loss.

509
510 This research study adds to the body of literature, regarding the audiological management of
511 children identified with a hearing loss, as well as early hearing detection and intervention services
512 available in South Africa. Although appropriate management strategies are in place, timing is of major
513 concern with regards to early identification, hearing aid fittings as well as introduction into aural
514 rehabilitation. It is hoped that this project will be motivation to provide early identification services in
515 Gauteng hospitals; as well as to provide a stepping stone on further research into the long term
516 management and follow up of children identified with a hearing loss in South Africa. Future research
517 could also include longitudinal efficacy studies where cultural and linguistic diversity aspects of the
518 country and their possible influence on EHCI are explored.

519 These results show that once identified with a hearing loss, the majority of children are
520 receiving behind-the-ear hearing aids. 85.7% of children who were identified with a hearing loss
521 received amplification and all children identified with a bilateral hearing loss were aided bilaterally.

522
523 Majority of children in the current South African sample, 48.57% are utilising an Auditory
524 Verbal Therapy approach, 18.57% are utilising sign language as a means of communication, and
525 11.43% are using a total communication approach. Unfortunately 14.29% were found not to be
526 receiving aural rehabilitation therapy.

527
528 Another aspect to consider is the importance of follow up, as many children are being lost to
529 the system and not benefiting from the services provided. The results from this study highlight the
530 need to put in place appropriate follow up services to ensure that children, once identified with a
531 hearing loss, are being fitted with amplification timeously as well as receiving appropriate intervention.
532 Audiologist need to advocate for early hearing detection and intervention to mitigate for the well
533 documented effects of unidentified hearing loss.

534
535
536
537
538
539
540
541
542
543
544
545
546
547
548
549
550
551
552
553
554
555
556
557
558
559
560
561
562
563

REFERENCES

1. ~~Bowe, F. W.~~ (2004). *Early Childhood Special Education: Birth to Eight*. New York: Delmar Learning, 2004.
2. Health Professions Council of South Africa (HPCSA). (2007). Early hearing detection and intervention programmes in South Africa position statement year 2007. Retrieved from Available: [http://www.hpcsa.co.za/hpcsa/UserFiles/Files/Speech%20language%20and%20hearing/EHDI5position%20statement%20\(HPCSA%2007\).pdf](http://www.hpcsa.co.za/hpcsa/UserFiles/Files/Speech%20language%20and%20hearing/EHDI5position%20statement%20(HPCSA%2007).pdf).
3. Storbeck, C., & Pitman, P. (2008). Early intervention services in South Africa: Moving beyond Hearing screening. *International Journal of Audiology*, 2008; (47):s36-s43.

Formatted: Font: Italic, English (South Africa)

Formatted: Font: Not Italic, English (South Africa)

- 564 4. Yoshinago-Itano, C., Sedey A.L., Coulter B.A., and Mehl A.L. (1998). Language of early and
565 later-identified children with hearing loss. *Pediatrics*. 1998; (102): 1168-1171.
- 566 5. Swanepoel, D., Delport, S., & Swart, J. (2004). Universal newborn hearing screening in South
567 Africa - a First-World dream? *SAMJ*. 2004; 94 (8): 634-635.
- 568 6. Yoshinago-Itano, C. (2004). Levels of evidence: Universal newborn hearing screening
569 (UNHS) and early detection and intervention (EHDI) systems. *Journal of Communication
570 Disorders*. 2004; 37: 451-65.
- 571 7. Morton, C.-C., & Nance, W.-E. (2006). Newborn hearing screening—A silent revolution. *New
572 England Journal of Medicine*. 2006; (18): 2151–2164.
- 573 8. Olusanya, B.-O., Luxon, L.-M., & Wirz, S.-L. (2004). Benefits and challenges of newborn
574 hearing screening for developing countries. *International Journal
575 of Pediatrics Otorhinolaryngology*. 2004;(68): 287–305.
- 576 9. Olusanya, B.-O. (2004). Early Detection of Hearing Impairment in a Developing Country: What
577 Options? *International Journal of Audiology*. 2001; 40 (3): 141-147.
- 578 10. Swanepoel D.W., & Storbeck C. (2008). EHDI Africa: Advocating for infants with hearing loss in
579 Africa. *International Journal of Audiology*. 2008; 1-S.
- 580 11. Khoza-Shangase, K., Barrat, J., and Jonosky, J.-B. (2010). Protocols for early audiology
581 intervention services: Views from early intervention practitioners in a developing country. *SA
582 Journal of Child Health*. 2010; 4(4): 100-105 4(4)100.
- 583 12. Tye-Murray, N.-M. (2009). Foundations of Aural Rehabilitation. Children, Adults and of their
584 Family Members. (3rd ed). USA: Delmar Cengage Learning; 2009.
- 585 13. Russ, A., Hanna D, DesGeorges, J., and Forsman, I. (2010). Improving Follow-up to Newborn
586 Hearing Screening: A Learning-Collaborative Experience. *Pediatrics*. 2010; Vol.
587 126; Supplement August 2010, pp. S59-S69
- 588 14. Swanepoel, D., Storbeck, C., & Friedland, P. (2009). Early hearing detection and intervention
589 in South Africa. *International Journal of Pediatric Otorhinolaryngology*. 2009; 73: 783-786.
- 590 15. Schiavetti, N., & Metz, D.-E. (2002). Evaluating Research in Communicative Disorders. 4th
591 Ed. (4ed). Boston: Allyn & Bacon; 2002.
- 592 16. Maxwell, D., & Satake, E. (2006). Research and statistical methods in communication
593 sciences and disorders. New York, NY: Thomson Delmar Learning; 2006.

Formatted: Font: Not Italic, English (South Africa)

Formatted: Font: Not Italic

Formatted: Font: Not Italic

Formatted: Font: Not Italic, English (South Africa)

Formatted: Font: Not Italic, English (South Africa)

Formatted: Font: Not Italic, English (South Africa)

Formatted: Font: Not Italic, English (South Africa)

Formatted: Font: Not Italic, English (South Africa)

Formatted: Font: Not Italic, English (South Africa)

Formatted: Font: Not Italic, English (South Africa)

Formatted: Font: Not Italic, English (South Africa)

Formatted: Font: Not Italic, English (South Africa)

Formatted: Font: English (South Africa), Superscript

- 594 17. Swanepoel, D.-W. (2006). Audiology in South Africa. *International Journal of Audiology*.
595 2006; 45 (5); 262-266.
- 596 18. Olusanya, B.-O., Luxon, L.-M., & Wirz, S.-L. (2005). Screening for early childhood hearing loss
597 in Nigeria. *Journal of Medical Screening*. 2005; 12:115–118.
- 598 19. Kanji, A., Khoza-Shangase, K., & Ballot, D. (2010). Hearing Screening follow up return rate in
599 a very low birth weight project: A retrospective record review. *SA Journal of Child Health*.
600 2010; 4 (4):95-99.
- 601 20. Noble W, Gatehouse S. (2006). Effects of bilateral versus unilateral hearing aid fitting on
602 abilities measured by the Speech, Spatial, and Qualities of Hearing Scale (SSQ).
603 *International Journal of Audiology*. 2006; 45(3):172-81.
- 604 21. Estabrooks. W. 1997. Auditory- Verbal therapy for parents and professionals. Alexandra
605 Graham Bell Association for the Deaf: Washington; 1997.

Formatted: Font: Not Italic, English (South Africa)

Formatted: Font: Not Italic, English (South Africa)

Formatted: Font: Not Italic, English (South Africa)

Formatted: Font: Not Italic, English (South Africa)

606
607
608
609
610
611
612
613
614
615