

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

3

4 **ABSTRACT**

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

7 **Study design and methods:** A retrospective record review was conducted, with 70  
8 files/medical records of paediatric patients between the ages of birth and 3 years were  
9 reviewed of participants from 3 state hospitals' audiology clinics

10 **Results:** The results of this study indicated that on average children were identified with a  
11 hearing loss at 23.65 months. They received amplification 7.11 months after diagnosis and  
12 were introduced into aural rehabilitation at the average age of 31.2 months. 81% of children  
13 received appropriate audiological tests. 85.7 % of children who were identified with a hearing  
14 loss received amplification and all children identified with a bilateral hearing loss were aided  
15 bilaterally. 48.57 % of the children identified with a hearing loss received auditory verbal  
16 therapy approach, 18.57 % received sign language as a means of communication, and  
17 11.43% received a total communication approach. 14.29 % were not receiving aural  
18 rehabilitation therapy. Findings raise important implications for the success of early hearing  
19 detection and intervention (EHDI) initiatives in South Africa.

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

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28 **1. INTRODUCTION**

29 Early intervention is defined as intervention practices for children from the ages of birth until 3  
30 years of age [1]. In the 2007 position statement by the Health Profession Council of South Africa  
31 (HPCSA) it is stated that: "Early hearing detection and intervention programmes are recommended to  
32 identify, diagnose and treat newborns and infants with a disabling hearing loss as early as possible to  
33 ensure that optimum, cost effective solutions, that enable persons to communicate effectively,  
34 allowing them to develop to their maximum potential, and thereby to secure their full participation in  
35 and contribution to, society and the country's economy" [2].

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

44 Universal Newborn Hearing Screening (UNHS) programmes prove to be beneficial as they  
45 allow for early detection of a hearing loss in children and subsequent intervention leads to linguistic,  
46 speech and cognitive development that is comparable to their normal hearing peers [6]. Because of  
47 this, early detection and intervention for infants with hearing loss is becoming standard practice in  
48 developed countries [7]. In countries such as America and the United Kingdom, UNHS programmes  
49 have been recently implemented [4]. Up until 1990 children born with a hearing loss would have only  
50 been identified by the ages of 2.5 to 3 years old [4]. However, with the implementation of EHDI  
51 services and UNHS, the average age of identification and confirmation of hearing impairment in

52 developed countries has decreased to 2-3 months [4]. The results of this study provides' information  
53 regarding the age of identification and confirmation of hearing loss in the South African context.

54 Unfortunately implementing EHDI programmes has not carried over to the developing world  
55 which is home to two thirds of the world's children with hearing loss [8]. In places where UNHS has  
56 not been implemented, hearing loss is only detected as a consequence of parental concerns  
57 regarding delays in speech and language development [9]. In developing countries the detection  
58 period usually only begins from two years of age and extends well into the adolescent years [9].

59 A study by Swanepoel and Storbeck [10], regarding the prevalence of hearing loss in South  
60 Africa, within the private and public health care settings. revealed that, in the private sector, which  
61 services 15% of the total population, the prevalence of hearing loss is 3 in every 1000 births, which  
62 translates to an annual rate of 496 and a daily rate 1.5 of people born with a hearing loss [10]. In the  
63 public sector which servicesup 85% of the population, the prevalence of hearing loss is 6 in every  
64 1000 births which is an annual rate of 5620 and a daily rate of 15.5 per day of people born with a  
65 hearing loss [10].

66 With such a high prevalence of hearing loss in the public health sector in South Africa, there is  
67 limited research into the early intervention services provided in this population [11]. This may be due  
68 to the low audiologist-to-patient-ratio and heavy clinical service load, particularly in the public sector  
69 [11]. The majority of audiologists work in the private health care sector which services only the  
70 minority of the population ([11].

71 According to Storbeck and Pitman [3], there are three stages to EHDI. The first stage is that of  
72 identification, comprising of screening of hearing loss. The second stage is that of referral to  
73 diagnostic tests [3]. This involves the confirmation of a hearing loss [3].The final stage of hearing  
74 detection and intervention involves intervention services [3]. The current study therefore aimed to  
75 explore the audiological management of paediatric patients through all these stages outlined by  
76 Storbeck and Pitman [3].

77 Most infants and their families will enrol in aural rehabilitation at 3 years of age [12]. Aural  
78 rehabilitation is intervention aimed at minimising and alleviating the communication difficulties

79 associated with a hearing loss [12]. There are a variety of approaches to long-term intervention [13].  
80 Most programmes and approaches aim to equip the child's parents with the skills and tools needed to  
81 facilitate the child's communication abilities. Most of the assistance focuses on language  
82 development, which often includes auditory stimulation [13]. Results of the current study provided a  
83 description of the communication/intervention approaches being offered in Gauteng Hospitals.

84 Follow-up is the most difficult part of an EHDI programme, and it is vital that any obstacles to  
85 follow-up be identified [14]. Audiologists and other health care professionals can help ensure follow-  
86 up return rates by providing good and relevant communication with caregivers [14]. Communication  
87 with caregivers can include; education and counselling regarding the risk factors for hearing loss, the  
88 importance of early identification, the significance of follow-up visits, and the implications of  
89 undetected hearing loss [14].

90 Variables such as age of diagnosis, nature of intervention and rehabilitation have not yet been  
91 comprehensively examined in South Africa, where the nature of early intervention is affected by the  
92 country being both a developed and a developing one [14]. While extensive literature is available on  
93 the practices and models of early intervention in developed countries, little information is available in  
94 developing countries where policies and practices are arguably largely inadequate [14]; hence the  
95 current study.

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## 99 **2. METHODOLOGY**

### 100 **Primary Aim**

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

103 **Secondary Objectives**

- 104 • To establish the age of identification of children hearing impairment
- 105 • To determine the audiological assessment tools utilised with this population
- 106 • To determine if amplification is provided in children identified with a hearing impairment
- 107 • To establish the time period between diagnosis of hearing loss and provision of amplification
- 108 • To determine the type of amplification provided
- 109 • To determine if bilateral amplification was provided where indicated.
- 110 • To determine what mode of communication is being utilised.

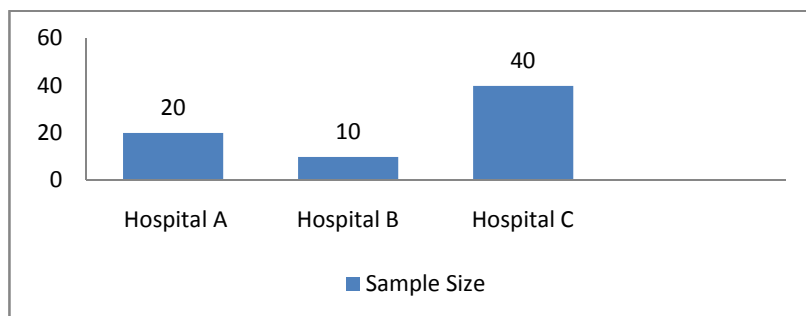
111 **Design of the Study**

112 This study adopted a retrospective record review. A retrospective study is designed to  
 113 examine data that is already on file; therefore, the researcher makes observations and can provide  
 114 descriptive statistics from this data [15].

115 **Participants**

116 **Description of participants:**

117 a) Sample size



118  
 119 **FIGURE 1: Depiction of Number of Participants (N=70)**

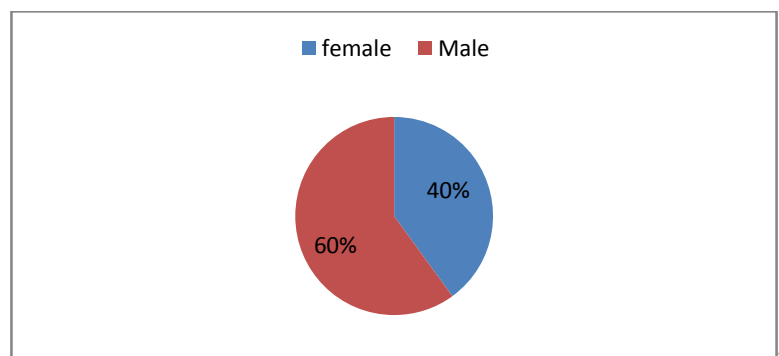
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121 The Sample Size consisted of 70 files, with 20 files from Hospital A, 10 files from Hospital B and 40  
122 files from hospital C as depicted in figure 1.

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124 b) Gender:

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

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

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132 c) Types of hearing loss in the sample:

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137 **TABLE 1: Types of Hearing Loss in the sample (N=70)**

Type of hearing loss	Percentage of participants
Bilateral severe to profound SNHL	29%
Bilateral profound SNHL	20%
Bilateral severe SNHL	17%
OAE bilateral fail	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	1%
Unilateral moderate SNHL	1%

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139 From Table 1 above, it is seen that the types of hearing loss of the children whose files were  
 140 included in the current study ranged from unilateral to bilateral, mild losses to profound losses; with  
 141 nature being only sensorineural hearing loss. Bilateral profound hearing losses were the most  
 142 common types of hearing loss diagnosed. This may have been due to the fact that a profound loss is  
 143 easier to be identified by parents and caregivers than a moderate or mild hearing loss. Parents are  
 144 bringing their children for an audiological examination because of concerns regarding delays in  
 145 speech and language development.

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## 148 **Sampling Procedure**

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

## 153 **Data analysis and statistical procedures**

154 This study made use of descriptive statistics. Descriptive statistics are utilized to observe  
 155 group differences, developmental trends or relationships among variables that can be measured by  
 156 the researcher [15]. "Research of this type provides an empirical picture of what was observed at one  
 157 time or of observed changes over a period of time, without the manipulation of independent variables  
 158 by the researcher" [15]. The independent variables in this study were as follows; age, gender, type of  
 159 hearing loss, audiological assessments, amplification, age of introduction into aural rehabilitation and  
 160 mode of communication. Generation of graphical/tabular representation in which the values of each  
 161 variable is plotted against the number of times it occurred allows the researcher to provide and  
 162 organise scores and observations in a summarised fashion [16].

## 163 **3. RESULTS AND DISCUSSION**

### 164 **Age of identification of hearing loss**

165 In addressing the specific aim of establishing the age of identification of children with  
 166 hearing impairment, results are depicted in Table 2.

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**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

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171 The results indicated the children's ages of hearing loss identification ranged from 2 weeks to  
 172 3 years 3 months, with a mean age of identification being 23.65 months, the median age was 26



173 months and the mode age was 36 months. The HPCSA position statement states that children should  
174 be identified by the age of 3 months [2]; a recommendation which was not realised in the data from  
175 the current study where children were being identified much later than 3 months. Previous findings  
176 have found that the best way to identify hearing loss as early as possible is via UNHS [9]. However  
177 this is not the common practice in the Gauteng state hospitals, or across the country. The current  
178 study suggested that hearing loss was being detected as a result of parental concerns as opposed to  
179 UNHS and consequently the detection period may be from 2 years of age until as late as adolescents  
180 [9]. This supports current findings and raises implications for implementing early hearing detection  
181 services for all children born, and not just those children deemed at risk.

182

183 Swanepeol [17], states that there are an insufficient number of audiologists; and these  
184 audiologists are unequally distributed between the private and public sector, with the public sector  
185 being significantly under-staffed for the population size they service. The low audiologist to patient  
186 ratio can possibly be the biggest challenge in the provision of adequate audiological services in South  
187 Africa [17]. Children who are not referred for early audiological services, fail to be diagnosed early,  
188 therefore highlighting the importance of educating doctors as well as allied health professions and  
189 nurses regarding hearing loss in order for appropriate referrals to be made [17]. Failure to detect a  
190 hearing loss may result in significant consequences for the child's speech and language acquisition,  
191 academic performance as well as social and emotional wellbeing [1]. If appropriate referral and early  
192 identification of hearing loss does not occur then early rehabilitation and management cannot be  
193 established.

194

### 195 **Audiological evaluations**

196 In addressing the second aim of establishing the audiological evaluation of children with  
197 hearing impairment; results indicated that 81% of children received the appropriate audiological  
198 intervention. Results were further analysed and 88% of the children received an otoscopic  
199 examination, 81% middle ear tests such as tympanometry, 68% received subjective testing, 82%  
200 received an OAE and 78% of the children underwent an ABR. From the current findings, it was clear  
201 that the majority of participants (approximately 81%) underwent appropriate and accurate audiology  
202 evaluations that included both behavioral and objective measures. These findings are consistent with

203 the JCIH recommended test batteries for infants. Research has shown that audiology services within  
204 the South African context are significantly influenced by equipment constraints. In the public  
205 healthcare sector, progress is due to limited availability of equipment, outdated and unrepaired  
206 equipment [17].

207

### 208 **Amplification**

209 The third aim of the current study was to identify whether children were provided  
210 with amplification. From the data collected, 60 out of 70 (85.71%) children were fitted with  
211 amplification. Of the 10 that were not fitted, 8 had not returned to the audiology clinics for follow up  
212 after they had been diagnosed with a hearing loss, 1 was awaiting results from an ABR and 1 was  
213 booked for a recheck as a clear and consistent diagnosis had not been made. Considering the costs  
214 associated with amplification and limited recourses under which state hospitals function, the fact that  
215 a large majority of the participants were aided is a positive finding. Previous findings have identified  
216 that the provision of amplification as soon as possible after a child is identified with hearing loss, is of  
217 crucial importance as a lack of auditory stimulation will affect the development of the child's speech  
218 and language skills [18]. If children with hearing loss are provided with amplification between 6- 12  
219 months it will allow them to develop age appropriate spoken language and cognitive skills [18]. Current  
220 findings are very positive for the South African context specifically within the government healthcare  
221 sector, indicating that once identified with a hearing loss, at least 85% of children received  
222 amplification. The remaining 10 children did not receive amplification, because they did not return for  
223 follow up services. Lack of awareness with regard to hearing loss, and the impact that a hearing loss  
224 can have on the child's development has been identified as contributing factors towards failure to  
225 return for follow up [17].

226

### 227 **Type of amplification**

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

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**TABLE 3: Types of Amplification Provided in the current sample**

Type of amplification	Number of participants	Percent
Behind-the ear Hearing Aids	52	86.66%
Bone Anchored Hearing aids	3	5 %
Cochlear Implants	3	5%
Referrals not in district *	2	3.33%

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### 249 **Timing**

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The results showed that 86.66% children received behind-the-ear hearing aids, 5% received Bone Anchored Hearing Aids (BAHA), 5% received cochlear implants, and 3.33 % were referred because they were not within the hospital district. Findings of the current study reveal that 86.66% of children who received amplification received behind-the ear hearing aids. Previous reports have stated 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 outer ear pathologies. 5% of participants in the current study 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].

In addressing the specific aim of the time lapse between 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.

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**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

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262           These findings are inconsistent with the study conducted by Swanepoel [10] in urban South  
 263 Africa, that the average amount of time between diagnosis and fitting was 5 months. The results of  
 264 the current study indicated that the average age of identification of a hearing loss is 23 months, and  
 265 the average waiting period to be fitted with a hearing aid is 7 months. Children only received  
 266 amplification at 30 months and therefore missed out on the critical periods of accessing residual  
 267 hearing for language acquisition. Previous research suggests that amplification between 6 to 12  
 268 months allows children with hearing loss to develop spoken language and cognitive skills comparable  
 269 to their normal hearing peers [18].

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271           There may be different reasons for the long waiting period for amplification. In the public  
 272 health care system, administrative measures are reported to often be a major factor delaying the  
 273 availability and accessibility of hearing aids. Time delays linked to procurement processes result in  
 274 the late fitting of amplification. Furthermore, between the public and the private health care sectors,  
 275 audiologists are unequally distributed, with an insufficient number of audiologists in the public sector  
 276 [17]. Busy therapist schedules in the government sector due to the long waiting lists are another  
 277 contributing factor to this delayed amplification [17]. A further factor adversely effecting efficiency is  
 278 the hospital administration and the need to pay the hearing aid companies before hearing aids can be  
 279 fitted.

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281           These findings highlight the urgency for audiologists and other health care professionals to  
 282 ensure that good and appropriate communication with caregivers is in place so that early intervention  
 283 can be achieved. Education and counselling the reasons for early identification, the importance of  
 284 follow-up visits, and the implications of undetected hearing loss must be explained to the caregivers  
 285 [19].

286

287 **Unilateral versus bilateral fitting**

288 In addressing the specific aim of establishing whether bilateral or unilateral amplification was  
 289 provided, results indicated that all the children identified with a bilateral hearing loss were bilaterally  
 290 aided and all those identified with a unilateral hearing loss were unilaterally aided.

291 Research has shown that children with a bilateral hearing loss will benefit more from bilateral  
 292 amplification than those who are monaurally amplified. Binaural hearing aids provide benefit such as  
 293 clarity of speech and hearing in noisy conditions. A binaural fitting removes the need for strategic  
 294 positioning as well as supporting higher order functionalities through improvements in binaural  
 295 processing [20]. In light of this, the findings of this study indicate a better prognosis for the children in  
 296 terms of acquisition of speech and language skills during the aural habilitation process.

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298 **Age of introduction into aural rehabilitation**

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

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304 **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

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307 These findings are consistent with previous findings by Swanepoel [10], that the average age  
 308 of initial enrolment into an early intervention programme was 31 months. The HPCSA position paper  
 309 states that children must be enrolled in an early intervention programme before the age of 6 months  
 310 [2]. Previous findings have found that it is vital for EHDI to take place before 6 months so that the  
 311 child is able to maintain age appropriate development with regards to language skills [3]. Current  
 312 findings are therefore disappointing and concerning as they indicate a significantly delayed point of  
 313 entry to aural rehabilitation; which had a negative impact on their speech, language and cognitive  
 314 skills [18].

315

316 **Modes of Communication**

317 In addressing the specific aim of establishing the mode of communication being adopted with  
 318 the hearing impaired children in the public hospitals in Gauteng, results are depicted in Table 6.

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

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Mode of Communication			Per centage
Auditory Verbal Therapy (AVT)			57 %
Sign Language			18.
Total Communication			57 %
No Aural Rehab			11.
Referrals as not in district			43%
			14.
			29 %
			1.4
			3 %

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330 Results showed that 48.57% of children who receive aural rehabilitation were utilising an AVT  
 331 approach. 18.57% were using sign language as a mode of communication. 11.43% were using a total  
 332 communication approach and 14.29% did receive aural rehabilitation. Finding of this study showed  
 333 that in Gauteng state hospitals 48.57% of participants utilised an AVT approach, which allowed  
 334 children to effectively communicate through speech [21]. Sign Language was utilised by 18.57 % of  
 335 participants and gave them access into the deaf community [12]. 14.29% of participants did not  
 336 receiving aural rehabilitation. Failure to follow up has been reported to limit the effectiveness of early  
 337 identification efforts. Follow-up aural rehabilitation appointments are also crucial for the children  
 338 because of the progressive nature of paediatric hearing loss [17].

339

340 **Limitations**

341 There are limitations to this study. First, the data represent a relatively small percentage of  
 342 the participants. Second, the sample size was unequally distributed between the three different  
 343 hospitals. In addition, being that the record review approach was used; the researcher could only

344 make use of what information was available to them. Information may have been incorrectly recorded,  
345 or important information may have not been available.

346

#### 347 **Future research**

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

355

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

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362 Future research could also benefit from doing a longitudinal study and seeing whether these  
363 children are benefiting from aural rehabilitation and whether appropriate management is being done  
364 with a long term effect. As there is little research in the field of audiological management within the  
365 South African context, further research can be done in this area to expand the current findings and  
366 literature.

367

#### 368 **4. CONCLUSION**

369 This study investigated the audiological management of children who were identified with a  
370 hearing loss in the Gauteng state hospitals; in South Africa. The results of this study indicated that on  
371 average children are identified with a hearing loss at 23.65 months and they receive amplification 7.11  
372 months after diagnosis. They were introduced into aural rehabilitation after 31.2 months. This is  
373 significantly delayed when compared to the Health Professions' Council of South Africa's guidelines of

374 children being identified by 3 months and amplification being provided by 6 months of age. These  
375 results may be due to lack of parental knowledge regarding hearing loss, poor audiologist to patient  
376 ratio in the government sector as well as burden of disease priorities for both patients and healthcare  
377 providers.

378

379 81% of children are receiving the appropriate audiological intervention. One of the most  
380 important aspects of the current study that needs to be considered is the age of identification, which is  
381 as late as 23 months. This motivates for the importance and the need for new born hearing screening  
382 in Gauteng hospitals which could lead to earlier identification.

383

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

387

388 Majority of children in the current South African sample, 48.57% are utilising an Auditory  
389 Verbal Therapy approach, 18.57 % are utilising sign language as a means of communication, and  
390 11.43 % or using a total communication approach. Unfortunately 14.29 % were found not to be  
391 receiving aural rehabilitation therapy.

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

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