EARLY HEARING INTERVENTION AND SUPPORT SERVICES PROVIDED TO THE PAEDIATRIC POPULATION BY SOUTH AFRICAN AUDIOLOGISTS

BY

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Psalm 19: 14

"May the words of my mouth and the meditation of my heart be pleasing in your sight, o LORD, my Rock and my Redeemer"

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- To You o, LORD, all the glory.

SUMMARY

TITLE: Early hearing intervention and support services provided to the paediatric population by South African audiologists.

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With the introduction of universal newborn hearing screening (UNHS) the need for quality early hearing intervention (EHI) services became critical. Screening is but the avenue to EHI services. Without appropriate intervention infants with hearing loss are at risk for language delay which might subsequently adversely influence academic success and vocational choices later on in life. The numerous socio-economic, cultural and healthcare barriers associated with developing countries such as South Africa, do not negate or diminish the need for optimal outcomes for infants with hearing loss through quality EHI services. The principle of quality EHI services, aligned with international standards, is endorsed by the HPCSA (2003: 2). In order to assure quality in EHI, service evaluation is critical. The necessary first step when evaluating service provision is to measure current service delivery. The main aim of this study was to determine whether South African audiologists provide EHI and support services aligned with international professional best practice to infants following the diagnosis of hearing loss.

The first part of this study reviews the evidence available in EHI. The guidelines derived from the international evidence were stated as benchmarks against which South African EHI services were measured. These benchmarks were categorised using the so-called six M variation categories. These categories are: Man, machine (equipment), method (systemaric procedures), measurements, material (amplification devices) and Mother Nature.

During the empirical research a descriptive design was followed comprising of questionnaire surveys to audiologists in different working sectors rendering EHI services to infants with hearing loss. The questionnaire survey explored the nature and scope of the EHI services offered to infants with hearing loss with regard to all the components (categorised in the six M categories) of the EHI programme of 40 South African audiologists.

The results of this study indicate that respondents often do not use evidence-based measurements or methods during EHI services. Results suggest that undergraduate training in areas regarding the selection and fitting of amplification to infants with hearing loss is often inadequate (>20 respondents indicated that they are not trained). Evidence-based measurements are not typically performed when fitting amplification to infants (29 respondents do not perform probe-microphone or elctroacoustic measurements). Many respondents indicated that they do not have the necessary equipment to do these measurements. EHI services often (50% of respondents) do not provide A/R directly, but refer to other team members. From the results there seems to be significant delays in the rendering of EHI services to infants with hearing loss. Financial constraints of the family of the infants, accessibility problems, as well as a lack of infant support from their families often influence the EHI programmes of respondents.

The implications of this study were discussed. Recommendations include the development of South African guidelines, aligned with international guidelines but taking into account the challenges posed by the unique South African context. Other recommendations include: Centres of excellence, relevant continuing education programmes and the evaluation of undergraduate training programmes.

Key words: Infants with hearing loss, early hearing intervention, quality monitoring, best practice guidelines, challenges in EHI, training of audiologists, hearing aid fitting, rehabilitation services, follow-up visits, components of EHI, South Africa, and questionnaire development.

OPSOMMING

TITEL: Vroeë-intervensie van gehoorverlies en ondersteuningsdienste gelewer aan die pediatriese populasie deur Suid Afrikaanse oudioloë.

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Met die aanvang van universele neonatale gehoorsifting is die lewering van hoë kwaliteit vroeë-intervensie vir gehoorverlies van kritiese belang. Sifting bied toegang tot vroeë-intervensie vir gehoorverlies. Sonder toepaslike vroeë-intervensie bestaan die risiko vir babas met gehoorverlies om ‘n taalagterstand te ontwikkel, wat weer kan lei tot akademiese agterstande en beperkte werksgeleenthede later van tyd. Die veelvuldige uitdagings wat die Suid-Afrikaanse konteks in terme van sosio-ekionomiese, kulturele en gesondheidsorg stel, verminder nie die behoefte aan optimale uitkomste vir babas met gehoorverlies wat deur hoë kwalitiet vroeë-intervensie moontlik gemaak word nie. Om kwaliteit te verseker is die evaluering van dienste krities. Die eerste stap van die evaluasie proses is om die aard van huidige dienslewering te ondersoek. Die hoofdoel van die studie was om die aard van vroeë-intervensie van gehoorverlies en ondersteuningsdienste gelewer aan die pediatriese populasie deur Suid Afrikaanse oudioloë te bepaal.

Die literatuurstudie bied ‘n oorsig oor die navorsing wat beskikbaar is in die vakgebied. Internasionale riglyne vir die lewering van vroeë intervensie dienste aan die baba met gehoorverlies is as maatstaf vasgestel waarteen Suid Afrikaanse dienslewering gemeet kon word. Hierdie maatstawwe is gekategoriseer in die sogenaamde ses M kategorieë waarvolgens variasie in ‘n proses beskryf kan word.

Die kategorieë is: Man, masjien (toerusting), metode (sistematiese prosedures), metings, materiaal (gehoorversterking) en Moeder Natuur.

Tydens die empiriese ondersoek is ‘n beskrywende opname ontwerp gevolg. ‘n Vraelys is ontwerp (gegrond op die internasionale maatstawwe), en aan pediatriese oudioloë wat in verskillende sektore werk gestuur. Die vraelys het inligting rakende al die komponente van die vroeë intervensie program vir babas met gehoorverlies ondersoek. Veertig oudioloë het deelgeneem aan die studie.

Resultate dui daarop dat respondente meestal nie prosedures en metings gebruik wat empiries gefundeerd is nie. Resultate dui daarop dat die voorgraadse opleiding van die respondente in baie gevalle (n>20) nie voldoende blyk te wees in areas met betrekking tot gehoorapparaat seleksie en passing nie. Objektiewe metings (werklike-oor metings en elektroakoestiese metings) word selde gebruik om gehoorapparaat passings te verifieër (slegs 11 respondente het gebruik daarvan aangedui). Die gebrek aan toepaslike toerusting is meestal as rede aangevoer. Die helfte van die respondente het voorts aangedui dat hulle nie self die ouditiewe rehabilitasie dienste bied nie, maar daarvoor verwys na ander spanlede. Dit het ook geblyk dat vroeë-intervensie dienste nie dadelik beskikbaar is vir babas met gehoorverlies nie. Faktore wat die lewering van dienste beinvloed is finansiële inperkinge, ontoeganklikheid, en ‘n verlies aan familiële ondersteuning vir die baba met gehoorverlies.

Implikasies van die studie, wat onder andere die ontwikkeling van Suid Afrikaanse riglyne insluit, is toegelig. Ander aanbevelings sluit in: Die ontwikkeling van uitnemendheidssentrums, waar dienslewering van hoë kwaliteit sal wees, voortgesette opleiding van oudioloë en evaluasie van voorgraadse kursusse.

Kernwoorde: Babas met gehoorverlies, vroeë intervensie vir gehoorverlies, kwaliteitsbestuur, standaarde, uitdagings in vroeë intervensie vir gehoorverlies, opleiding van oudioloë, ouditiewe rehabilitasie, opvolgbesoeke, vraelys, Suid Afrika.

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LIST OF ABBREVIATIONS

A/R	Aural Rehabilitation
AAA	American Academy of Audiology
ASHA	American Speech Language and Hearing Association
dB	decibel
DEESI	Deaf Education Early Service Index
DSL [i/o]	Desired Sensation Level [input/output]
DSL	Desired Sensation Level
EHI	Early Hearing Intervention
EHDI	Early Hearing Detection and Intervention
FM	Frequency Modulated
HPCSA	Health Professions Council of South Africa
HSPS	Hearing Screening Position Statement
Hz	Hertz
IFSP	Individualised Family Service Plan
JCIH	Joint Committee on Infant Hearing
n	number
NDCS	National Deaf Children's Society
PASI	Paediatric Audiology Service Index
RECD	Real Ear to Coupler Difference
SAHRC	South African Human Rights Commission
SHARP	Situational Hearing Aid Response Profile
SPL	Sound Pressure Level
SSPL	Saturation Sound Pressure Level
UNHS	Universal Newborn Hearing Screening
USPSTF	US Preventative Task Force
WDRC	Wide Dynamic Range Compression

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CHAPTER 1

MOTIVATION, BACKGROUND AND RESEARCH PROBLEM

Aim: To theorise and conceptualise the research issues in order to motivate the research aims and to provide a rationale for the study.

"In all affairs it's a healthy thing now and then to hang a question mark on the things you have long taken for granted"
(Bertrand Russel, 1872-1970)

1.1 INTRODUCTION

"*The principle of equal rights implies that the needs of each and every individual are of equal importance, that those needs must be made the basis for the planning for societies and that all resources must be employed … to ensure that every individual has equal opportunity for participation.*" (United Nations, 1993, as cited in South African Human Rights Commission (SAHRC), 2002: 24).

This principle of equal rights, equal participation, is particularly relevant for the South African situation as depicted in the South African constitution: "*We, the people of South Africa, … adopt this Constitution so as to - heal the divisions of the past and establish a society based on democratic values, social justice and fundamental human rights; … improve the quality of life of all citizens and free the potential of each person* …" (Constitution of the Republic of South Africa, 1996, as cited in SAHRC, 2002: 26).

Quality of life is important for everyone. Participation, whether in your own social circle, academic environments, community events or elsewhere, plays a crucial role in improving and maintaining quality of life. To disabled people participation might be hampered by their disability. Permanent hearing loss in children is the most prevalent congenital impairment, estimated to range from 1.5 to six per 1000 live births (Joint Committee on Infant Hearing (JCIH), 1994: 38). Their number exceeds the total amount of all other impairments discovered during newborn screenings (Wiesner, 2000, as cited in Bohnert, 2005: 261). A person with hearing loss might be excluded from specific environments, such as classroom discussions, as a result of his or her hearing loss. Without appropriate intervention children with permanent hearing loss[1] will not have the same opportunities as their hearing peers and will subsequently not reach their full potential. The principle of equal rights as imposed by the South African constitution will therefore be violated.

Quality of life is dependent on quality of communication, cognition and social behaviour, amongst others. The quality of communication, cognition, behaviour, social-emotional development, academic outcomes and later vocational opportunities of children are influenced by hearing loss as defined above (Karchmer & Allen, 1999: 77; JCIH, 2000: 11). Without appropriate opportunities to learn language, children with hearing loss will fall behind their hearing peers in language, cognition and socio-emotional development (JCIH, 2000: 11; Yoshinaga-Itano et al., 1998: 1161-1170). Subsequently they might not reach their highest

[1]This population can broadly be described as deaf, hard-of-hearing or children with hearing loss. The National Deaf Children's Society (NDCS) uses the term deaf to mean the full range of deafness that is mild, fluctuating, sudden, progressive, late onset, or unilateral deafness and also auditory neuropathy, resulting in central auditory processing disorders. For the purpose of this study the term infants (nought to three years) with hearing loss will be used and is defined as permanent bilateral or unilateral, sensory or conductive hearing loss of 20 dB or more in the frequency region important for speech recognition (approximately 500 Hz through 4000 Hz) (The Pediatric Working Group of the Conference on Amplification for Children with Auditory Deficits, 1996: 54).

possible educational level and might have lower employment levels as adults (Gaullaudet University Centre for Assessment and Demographic Study, 1998: 75). However, it has been proven that *infants with permanent hearing loss who start receiving intervention before six months of age maintain language development commensurate with their cognitive abilities through the age of five years* (Yoshinaga-Itano & Gravel, 2001: 63). The following quotation by Yoshinaga-Itano (1999: 317) stresses the importance of early identification and early intervention for the normal language development and eventually the quality of education, employment and ultimately the quality of life of children with hearing loss: "*Identification of deafness by six months of age, followed by appropriate intervention is the most effective strategy for the normal development of language in deaf and hard-of-hearing infants and toddlers*" (Yoshinaga-Itano, 1998: 63).

The necessary requirement for early hearing identification and intervention services (as discussed above) is the accessibility thereof to the child with hearing loss. In their position statement the JCIH (JCIH, 2000: 10) supports the goals of universal access to hearing screening, evaluation and intervention for newborns and infants embodied in Healthy People 2000 (US Department of Health and Human Services Public Health Service, 1990, as cited in JCIH, 2000: 10) and 2010 (US Department of Health and Human Services Public Health Service, 2000, as cited in JCIH, 2000: 10). The Professional Board for Speech, Language and Hearing Professions in South Africa accepts the JCIH 2000 position statement as the definitive document on infant hearing screening (HPCSA, 2002a: 1). In their hearing screening position statement (HSPS) year 2002 they endorse the principles set out by the JCIH positions statement 2000 (HPCSA, 2002a: 8). The JCIH (2000: 11) recommends that all infants' hearing should be screened using objective, physiologic measures and that an audiological evaluation should be in progress before three months of age. Hearing screening should identify infants at risk for specifically defined hearing loss that interferes with development. The targeted hearing loss is defined as permanent bilateral or unilateral, sensory or

conductive hearing loss, averaging 30 dB to 40 dB or more in the frequency region important for speech recognition (approximately 500 Hz through 4000 Hz)(JCIH, 2000: 11). They further propose that infants with confirmed hearing loss should be enrolled for early hearing intervention (EHI) services before six months of age**.** *Early identification alone is unlikely to result in improved outcomes if it is not followed by early intervention* (Yoshinaga-Itano et al., 1998: 1170). This view is supported by Bamford (2000: 359), who proposes that infant hearing programmes have as their purpose the identification, management, and the support of children with hearing loss and their families.

1.2 RATIONALE AND PROBLEM STATEMENT

With a worldwide movement towards universal newborn hearing screening, the need to ensure good, accurate, family-friendly hearing services to meet each child with a hearing loss and his/her parents' needs, becomes more critical. It is clear that screening is only the beginning of the process. Screening relies upon paediatric[2] audiological services that meet the individual needs and provide optimum support to all children with permanent hearing loss, to be in place (National Deaf Children's Society (NDCS), 2000: 1). However, the development of *high quality EHI services* that are able to respond to all the possible combinations of child and family needs is a major challenge (Gravel, 1995: 5). The Longman Family Dictionary (1984: 558) defines quality as "degree of excellence" or the "quality of something is how good it is". According to Bamford

[2] For the purpose of this study language and spelling would be based on United Kingdom English. When reference is made to 'The Pediatric Working Group of the Conference on Amplification for Children with Auditory Deficits (1996)' the spelling of the word 'paediatric' would be adapted to 'pediatric', as it refers to the name of this specific USA based group. The same for the American Academy of Audiology's 'Pediatric Amplification Protocol'.

(2000: 359) developing high quality EHI services is a challenge that has been met poorly for the most part. EHI services should be *evidence-based* and *quality monitoring* should be a key aspect of this service provision (Bamford, 2000: 329).

Evidence-based practice is an approach to clinical service delivery that has become increasingly advocated in the past decade (McKibbon, 1999 as cited in Gravel, 2005: 17). The South African government also encourages the development of a culture of evidence-based decision-making in health care (Department of Health, 2001: 2). Evidence-based medicine is defined as the "contentious, explicit and judicious use of current best evidence in making decisions about the care of patients…achieved through integrating individual expertise with access to systematic evidence" (Oxford-centre for Evidence-Based Medicine, 2005: 1). Advocates of evidence-based audiology have argued that with the explosion of information and technology audiologists cannot continue to rely on the information and skills they acquired in their formal professional and clinical training programmes (Gravel, 2005: 18).

In the endnote of the first international conference: A sound foundation through early amplification 1998, in Chicago, Illinois, Bess concludes that only the implementation of evidence-based paediatric audiology practice can lead us to the highest quality service provision for children with a hearing loss (Bess, 2000: 250). Earlier in 1995 Bess suggests in a "viewpoint" article in the *American Journal of Audiology* (1995: 5) that evidence-based audiology requires deliberation from audiologists who find themselves practicing in an ever-changing health care environment. He calls for a "new practice of audiology", an approach to clinical service delivery that: 1) de-emphasises intuition and unsystematic clinical experience as the basis for clinical decision-making; and, 2) stresses the need to understand the rules of evidence in order that audiologists might interpret the

clinical and hearing science literature appropriately, and subsequently make their own independent judgments regarding the evidence.

These principles are in accordance with another definition of evidence-based medicine by Timio and Antiseri (as cited in Hyde, 2005: 281): "...an emerging paradigm of scientifically based clinical care. It de-emphasises intuition and unsystematic clinical experience...". This definition touches on both the key strengths as well as the key weaknesses of evidence-based medicine (Hyde, 2005: 281). Critics of evidence-based medicine have suggested that it is too stringent (Gravel, 2005: 17). There are also significant concerns about the ethics of evidence-based practice itself. One such concern, for example, is that the focus of evidence-based practice may actually detract from the care provided to the individuals, who may not fit the norm of the large population (Hyde, 2005: 297). The definition of evidence-based practice by the Oxford-centre for Evidence-based Medicine (2005:1) recognises this concern and stresses the importance for evidence-based medicine to consider each individual's unique situation, recognising the preferences, expectations, culture and feelings of the patient into the clinical decision-making process (Oxford-centre for Evidence Based Medicine, 2005: 1).

The other side of the ethics coin is that it is unethical to knowingly implement a programme of poor quality. The concept of equity, both equity of access to services and equity of quality of the service, implies that there is an ethical onus on the service providers to maximise their consistency of practice across the entire programme, guided by existing evidence (Hyde, 2005: 300). Bamford (2000: 359) proposes that there is not only good evidence of considerable inequity of service provision between countries but also within countries. The findings of a survey by Hedley-Williams, Tharpe and Bess (1996: 107-120) support this notion. The survey found that few audiologists at the time were using a systematic approach to hearing aid fitting for infants and young children and that there were a small

number of clinicians employing an evidence-based paediatric prescriptive method (1996: 120). In a follow-up survey conducted by Tharpe (2000: 175-187), service delivery to children with multiple impairments were evaluated and compared to service delivery to the otherwise normally developing child with a hearing loss. Results revealed that there had been some increase in the proportion of audiologists using an evidence-based paediatric prescriptive hearing aid fitting procedure, but the results also illustrate a need for improvement (Bess, 2000: 248, Tharpe, 2000: 182).

Thus, the lack of evidence-based practice in paediatric audiology continued despite highly complex, rapidly changing amplification technology and real-ear measurement equipment, as well as the availability of published selection and fitting protocols specifically developed for the purpose (The Pediatric Working Group of the Conference on Amplification for Children with Auditory Deficits[3], 1996: 253; Gravel, 2005: 19). There is no published systematic approach to the provision of EHI services in South Africa (Mencher & DeVoe, 2001 as cited in Swanepoel, 2004: 100). Documents of interest to South African audiologists pertaining to paediatric hearing screening and hearing aid fitting in general were published by the HPCSA. These are the Professional Board for Speech, Language and Hearing Professions' Hearing Screening Position Statement (HSPS)(HPCSA, 2002a: 1-8), and the Standards of Practice in Audiology (HPCSA, 2002b: 1-4). These documents endorse the evaluation of services to assure quality EHDI programmes and include some suggestions regarding the procedures necessary for the fitting of hearing aids (HPCSA, 2002a: 4). Yet, the guidelines necessary to assure consistent service delivery to all infants with hearing loss are limited with regard to all components of the EHI programme. Consistency of service provision should be maximised in pursuit of equity of care. Inequity of service provision

[3] For the remainder of the document 'The Pediatric Working Group of the Conference on Amplification for Children with Auditory Deficits' (1996) will be referred to as 'The Pediatric Working Group' (1996).

within South Africa is apparent due in part to the diversity of the country, rural versus urban, rich versus poor.

Diversity also prevails in the health care system of which EHI services form a part. The healthcare system in South Africa has a dualistic nature (Petros, 2001: 6). On the one hand there is the public health sector that is administered by the government and on the other hand there is the private health sector. The aim of the government is to promote the health of all South Africans through a national health system that is based on the primary health care approach (Department of Health, 2000, as cited in Petros, 2001: 6). The basis of this approach is found in the philosophy of “ubuntu”. Ubuntu philosophy holds that all people should be treated with respect and dignity, because a person becomes a person through other people. (Louw, 2005: 2). The South African Governmental White Paper on Welfare officially recognises ubuntu as: "The principle of caring for each other's well-being...and a spirit of mutual support...Each individual's humanity is ideally expressed through his or her relationship with others and theirs in turn through recognition of the individual's humanity. Ubuntu means that people are people through other people. It acknowledges both the rights and the responsibilities of every citizen in promoting individual and societal well-being" (Government Gazette, 1996, as cited in Louw, 2005: 2). Good health is seen as a prerequisite for social and economic development, and government and all associated health institutions should form strong partnerships to ensure steady improvement in quality of care (Department of Health, 2000, as cited in Petros, 2001: 7).

Based on the values underlying the ubuntu philosophy principles of the national health care system were formulated. The White Paper titled “An Integrated National Disability Strategy” (Mbeki, 1997: 22-26) calls for early identification of impairments and appropriate interventions as well as free access to assistive devices and rehabilitation services under the primary health care system for all children with disabilities under the age of six years. Free health care for children

under six years has not always been extended to include rehabilitation and the provision of assistive devices (HPCSA, 2002: 3). In the Professional Board for Speech, Language and Hearing Professions' HSPS, Dr Manto-Tshabalala-Msimang, Minister of Health, is quoted as saying: "We are often told that South Africa has some of the world's best policies. We acknowledge, however, that sometimes we struggle with their implementation" (HPCSA, 2002a: 3). To ensure the quality of life of all infants in South Africa with hearing loss, it is crucial to implement policies ensuring good quality EHI services.

The necessary first step in ensuring consistent good quality EHI is to investigate and describe the nature of these services to children with hearing loss by South African audiologists. If evidence is available about the nature of EHI services in South Africa, guidelines to ensure a systematic approach to the rendering of these services can be developed. Clinical practice guidelines provide recommendations for "best practice" and are intended to foster care targeted to specific audiences, in this case the infant with hearing loss in South Africa (Gravel, 2005: 23). The HSPS of the Professional Board for Speech, Language and Hearing Professions' (HPCSA, 2002a: 3) states that quantifiable goals and quality indicators should be determined for the monitoring and evaluation of EHDI programmes and that periodic review should take place to assure quality.

To develop good quality EHI and support programmes, a culture of *service evaluation* is critical (NDCS, 2002: 5). Hyde (2005) in the endnote of the third international conference: A sound foundation through early amplification 2004, concludes: "It is simply not possible to evaluate a programme that is not grounded in defined protocols and consistent practices" (Hyde, 2005: 300). The programme's inherent ability to be evaluated is also crucial over the long term to sustain and optimise EHI services (Hyde, 2005: 300). The following figure defines and describes the process of evaluating EHI to ensure good quality services.

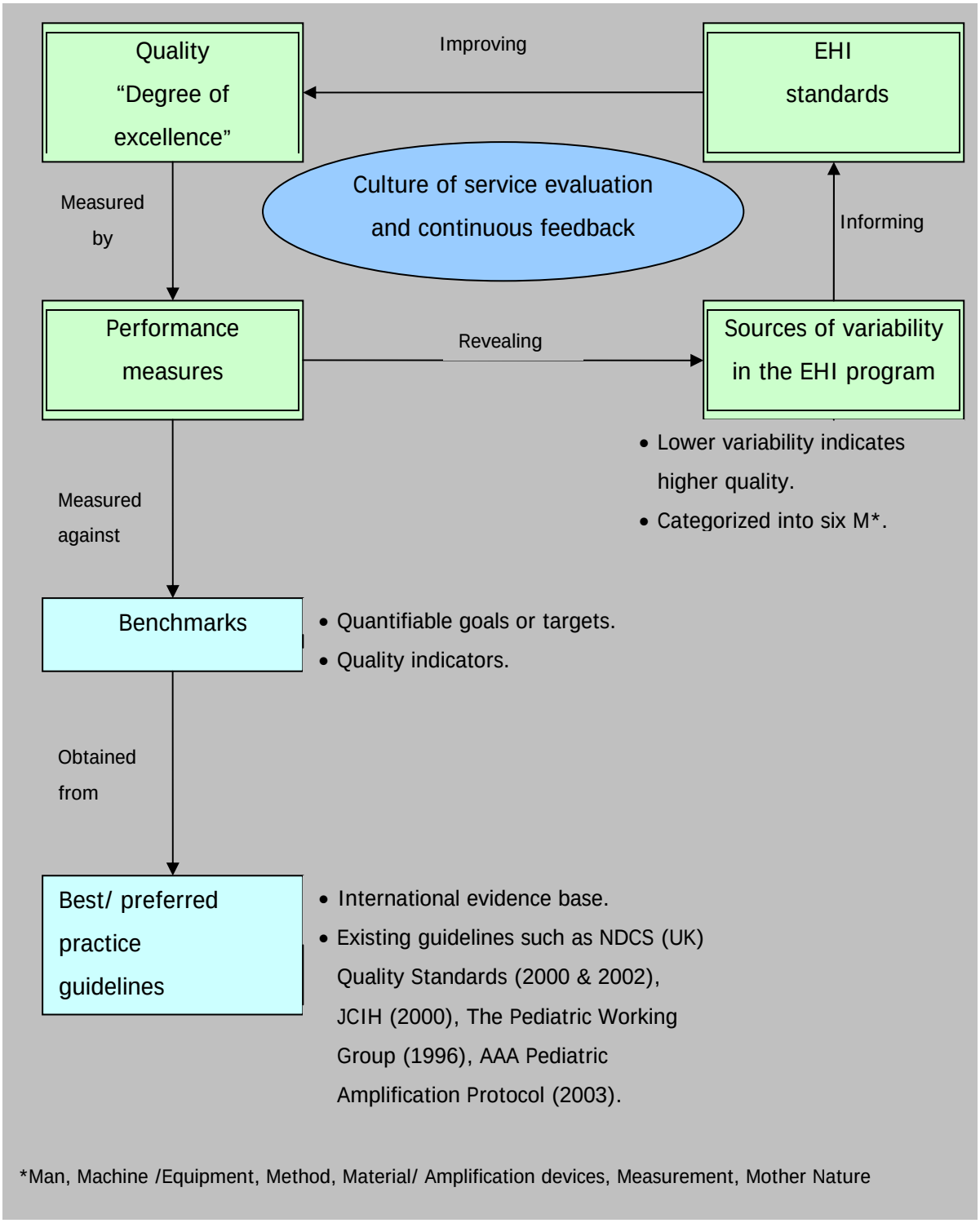


Figure 1.1 The continuous process of evaluating EHI services

(compiled from the JCIH, 2000; NDCS, 2000 & 2002; The Pediatric Working Group, 1996)

According to the graph (figure 1.1) service evaluation is a cycle where quality is measured by performance measures that are measured against benchmarks. These benchmarks are quantifiable goals or targets or indicators obtained from international best practice guidelines that reveal sources of variability in the delivery of EHI services. These sources of variability serve to inform EHI standards and subsequently improve the quality thereof.

The Joint Committee on Infant Hearing (2000: 11-12) proposes that service providers should undertake performance measures to examine whether the system conforms to accepted *standards of quality*. Quality or the degree of excellence of EHI services for children with hearing loss and their families can be measured against some *benchmarks* provided by *preferred/ or best practice guidelines* gathered from the considerable international evidence base (Bamford, 2001: 329). Examples of such existing guidelines include those from the United Kingdom (U.K.) National Deaf Children's Society (NDCS) (2000: 1-24 & 2002: 1-29), the Joint Committee on Infant Hearing (2000: 9-29), The Pediatric Working Group (1996: 53-68) and the American Academy of Audiology (AAA) Pediatric Amplification Protocol (2003: 1-19). The Joint Committee on Infant Hearing (2000: 12) defines benchmarks as quantifiable goals or targets by which an Early Hearing Detection and Intervention (EHDI) programme may be monitored and evaluated. Benchmarks are used to evaluate progress and to point to needed next steps in achieving and maintaining a quality programme (JCIH, 2000: 12).

If the quality indicators demonstrate that a programme is not meeting the stated benchmark, sources of *variability* should be identified and corrected to improve the process according to Tharpe and Clayton (as cited in JCIH, 2000: 12). This is in accordance with how "quality guru" Demming (as cited in Venkatesh, 2000: 1) describes quality. According to him quality can be controlled by controlling the amount of variation in a specific process. Quality is indirectly proportional to the amount of variation in a specific process. This is a necessary but not

sufficient condition for high quality. Guidelines set for EHI services should be of a sufficient standard to ensure a minimum level of quality. *By reducing the amount of variation relative to these guidelines, quality levels can be greatly improved***.** Causes of variation are categorised using the so-called "six M's": Man, machine, method, material, measurement and Mother Nature (Leansigmatech, 2003: 1). By using best practice guidelines for paediatric hearing intervention and categorising them into one of the above six M variation categories[4], variation in EHI services can be described and managed. The six potential variation categories are the following:

- The first category is the category **"man"**. This category includes everyone involved in the EHI process. This will include the infant or child with hearing loss, the audiologist, the team members in the EHI process and the infant's parents and family. Variation in the training of audiologists, for example, can influence their level of knowledge; in turn their level of experience might influenc1e their expertise.

- The next category is the category **"method"**. The word "method" refers to a systematic procedure for doing something, or an orderly system (Longman Family Dictionary, 1984: 431). This refers to the *protocol* or systematic procedures used in the EHI services.

- The third category is the category **"measurement"**. This includes all measurements during the early intervention services rendered to children with hearing loss. Examples of measurements in the intervention process are measurements for the selection and verification of electroacoustic characteristics

[4] For the purpose of this study the researcher will refer to the "six M" variation categories even though the category names will be adapted where necessary to suit the EHI context.

of, for example, probe microphone measurements of frequency response as well as measurements to validate the fitting (aided auditory function).

- The fourth category is the category **"machine"**. This category includes all the audiological equipment necessary to do the measurements during early hearing intervention services. For the purpose of this study the term **"equipment"** would be used rather than "machine" as it is more widely accepted as terminology in the field of audiology. For the selection and verification of electroacoustic characteristics of amplification, for example, a hearing aid black box is needed (Joint Committee on Infant Hearing, 1994).

- Category five is the category **"material"**. The Longman Family Dictionary (1984: 424) defines "material" as: "The apparatus necessary for doing or making something". For the purpose of this study the "material" would refer to the "**amplification devices"** used for the infant with a hearing loss. This would include hearing aids, assistive devices and cochlear implants (The Pediatric Working Group, 1996: 54).

- The sixth and last category is the category **"Mother Nature"**. According to the ecological theory, man can, similar to any other living creature, be regarded as a part and product of his environment (Caldwell and Levine, 1981, as cited in Hugo, 1990: 3). According to Levine (1981, as cited in Hugo, 1990: 3) environment can be classified into three main areas:
  - the natural environment (geographic and topographic factors, climate, atmosphere and weather patterns);
  - the manmade physical environment, for example the house or building the person works or lives in;
  - socio-cultural environment: In a third world country such as South Africa the socio-cultural environment will possibly have the greatest influence on an early intervention programme (Hugo, 1990: 3). Factors that might have

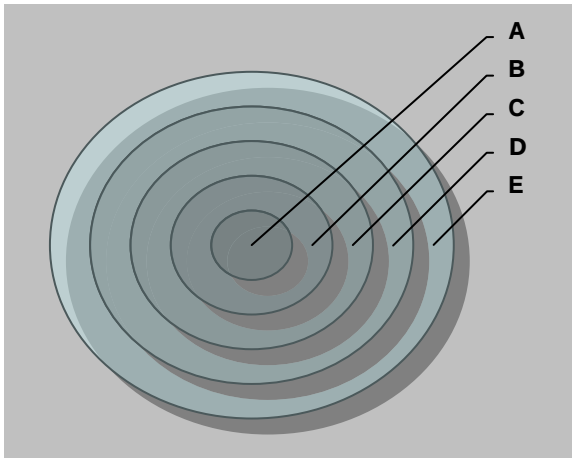
a great influence on variation in service provision to babies and young children include for example financial constraints and accessibility of health services.

The quality of EHI services for children with hearing loss in South Africa will be influenced by international benchmarks as well as the unique South African situation. Because of the apparent inequity of EHI service provision in South Africa (as highlighted earlier in this section), the researcher predicts that great variation in all areas of service delivery to the paediatric population of South Africa will be present. South African quality standards for EHI and support services might alleviate this problem, and help reduce variation in service provision. In the 2003 Mission Statement of the Professional Board of Speech, Language and Hearing professionals of South Africa, the first objective is to "*set* ***a new professional practice framework*** *in place,* ***aligned with international professional best practices***" (HPCSA, 2003: 1). It is thus essential that the ultimate aim should be to have audiological intervention services to infants and young children in South Africa aligned with international best practice guidelines and quality standards. Even though the international guidelines will assist in setting a framework for services to infants with hearing loss in South Africa, the following quotation stresses the importance of proposing strategies fitting the unique community in South Africa: "*Much international planning continues to be based on the assumption that the ways that have worked best in Western countries are the model to be followed in developing countries*" (Foster & Anderson, 1987, as cited in Hugo, 1990: 8).

Hugo (1990: 8) states that it is imperative that an early intervention programme in a rural community should have as a point of reference the socio-cultural environment of that specific community. According to Hugo (1990: 8) this implies that, although certain universal principles may be developed, it will be necessary to establish those strategies that are unique to every specific

community in South Africa. Financial problems of the clinic resulting in inadequate equipment or material, financial constraints of the parents of the child with hearing loss, lack of knowledge of the team members, accessibility problems and more might influence the service delivery of the South African audiologist to infants and young children with hearing loss.

Ultimately the process of EHI should be based on the evidence provided by the international body of knowledge, taking into account, however, the unique characteristics and challenges of the South African context. The planned study can be positioned as follows:



A	Infant with hearing loss
B	EHI services rendered by Audiologists *Area of current research
C	South African context
D	Future RSA best practice protocol/ guidelines in EHI
E	International best practice guidelines in EHI

Figure 1.2 Positioning of this research study

As demonstrated in this graph (figure 1.2) the infant with hearing loss is central in the process of EHI as rendered by the South African audiologists. The current study evaluates the EHI services rendered by South African audiologists in the realm of the South African context, placing it within the sphere of international best practice against which these services will be evaluated. Recommendations might include a South African best practice protocol that will in future encompass these services, ultimately changing the lives of infants with hearing loss in South Africa who is at the core of the conduct.

Against this background and in line with the principle of quality monitoring and improving EHI services, as stated by the JCIH (JCIH, 2000: 11), monitoring and improving the EHI services provided by South African audiologists is the ultimate aim. To realise this aim, knowledge of current performance is essential. The following research question is posed by this study: *What is the nature of the intervention and support services following diagnosis of hearing loss to the paediatric population by South African audiologists?*

1.3 BRIEF OUTLINE OF CHAPTERS

The primary focus of this study is to describe the nature and scope of the EHI services provided to infants with hearing loss by South African audiologists. The following table, table 1.1 delineates the division of chapters in this research study and provides a short summary of the contents of each chapter.

Table 1.1 Division and content of chapters

Chapter one:	Introduction Problem statement Rationale	• Provides an overview of the importance of timely, efficient EHI services and the monitoring of the quality of service provision. • The statement of the problem and the rationale for the study were placed against this background. • Definitions of terminology related to this study are given.
Chapter two:	Benchmarks in EHI services derived from international best practice guidelines.	• Reviews the existing evidence base, literature, defining international best practice guidelines in service provision to infants with hearing loss. • Relates controversies, benefits and limitations in this field.
Chapter three:	Methodology	Describes and outlines: • The operational framework of this study. • The aims of this study. • The research design and method. • The research procedures. • The validity and reliability of the study. • The ethical issues related to this study.
Chapter four:	Results and discussion	• The results obtained are presented with the relevant statistical analysis. • The results are presented according to the sub-aims stipulated in chapter three. • Interpretation and discussion of the results are presented. • The value and meaning in relation to the literature are discussed.
Chapter five:	Conclusion and implications	• Provides an outline of the significant results and the way they contribute to current literature. • Describes the clinical implications of this study. • Provides a critical evaluation of this study. • Future research recommendations are provided and a conclusion regarding the study is formulated.

1.4 CLARIFICATION OF TERMINOLOGY

It is necessary to clarify the following terms that are used frequently in this study:

- **Infant with hearing loss**

For the purpose of this study the term infant with hearing loss will be used and is defined as permanent bilateral or unilateral, sensory or conductive hearing loss of 20 dB or more in the frequency region important for speech recognition (approximately 500 Hz through 4000 Hz) (The Pediatric Working, 1996: 54). Even in optimal listening conditions, a minimal hearing loss (15 dB to 20 dB) is likely to be deleterious to an infant's ability to discriminate speech sounds (Nozza, 2000: 50). Terminology that has been used in the past regarding the infant with hearing loss include: Hearing impaired, deaf, hard-of-hearing or children with hearing loss. The National Deaf Children's Society (NDCS) uses the term deaf to mean the full range of deafness that is mild, fluctuating, sudden, progressive, late onset, or unilateral deafness and also auditory neuropathy, resulting in central auditory processing disorders. These terms will only be used if used by other authors and if it is important for the general comprehension of the content under discussion.

- **Evidence-based practice**

Evidence-based practice is defined as the "contentious, explicit and judicious use of current best evidence in making decisions about the care of patients...achieved through integrating individual expertise with access to systematic evidence" (Oxford-Centre for Evidence Based Medicine, 2005: 2)

- **Quality**

The Concise Oxford Dictionary (1987) defines quality as “degree of excellence”. Another definition of quality is that of the South African Student’s Dictionary (1996): “The quality of something is how good it is”. For the purpose of this study “high quality services” will refer to services implementing evidence-based principles. Guidelines set for EHI services should be of a sufficient standard to ensure a minimum level of quality.

- **Early hearing detection and intervention (EHDI)**

Early hearing detection and intervention refers to the detection or identification of hearing loss by three months of age and the subsequent intervention as recommended by the JCIH (JCIH, 2000: 10).

- **Early hearing intervention (EHI)**

Early hearing intervention refers to services rendered to the infant with hearing loss after identification of hearing loss. The aim should be to deliver intervention services for infants with hearing loss by six months of age (JCIH, 2000: 10). EHI services refer to the intervention/ remediation as well as support services available to the infants with hearing loss and his/her family immediately when the infant’s hearing loss is confirmed.

- **Benchmarks**

The Joint Committee on Infant Hearing (2000: 12) defines benchmarks as quantifiable goals or targets by which an EHI programme may be monitored and evaluated. Benchmarks are used to evaluate progress and to point to needed next steps in achieving and maintaining a quality programme (JCIH, 2000: 12).

- **Preferred / Best practice guidelines**

Clinical practice guidelines provide recommendations for "best practice" based on exhaustive review of the literature as well as clinical judgement. Guidelines are not required standards nor practice regulations; they are rather intended to foster care targeted to specific audiences (Rosenfield, 2003, in Gravel, 2005: 23).

- **Protocol**

According to the Longman Family Dictionary (1984: 548) a protocol refers to a code of correct etiquette. In audiology a protocol refers to a precise, detailed plan for the administration of a regimen of treatment (Stach, 1997: 168).

- **Six M variation categories**

According to '"quality guru" Edward Demming (in Venkatesh, 2000: 1) quality can be controlled by controlling the amount of variation in a specific process. Quality is indirectly proportional to the amount of variation in a specific process. By reducing the amount of variation relative to these guidelines, quality levels can be greatly improved. Causes of variation are categorised using the so-called "six M's": Man, machine, method, material, measurement and Mother Nature (Leansigmatech, 2003: 2). For the purpose of this study the researcher will refer to the "six M" variation categories even though the category names will be adapted where necessary to suit the EHI context. The term "equipment" would be used rather than "machine" as it is more widely accepted as terminology in the field of audiology. For the purpose of this study the "material" would refer to the "amplification devices" used for the infant with a hearing loss. This would include hearing aids, assistive devices and cochlear implants (The Pediatric Working Group, 1994: 54).

- **Probe-microphone measurements**

  This refers to electroacoustic assessment of the characteristics of hearing aid amplification near the tympanic membrane using a probe microphone (Stach, 1997: 167).

- **Electroacoustic**

Pertaining to the conversion of an electric signal to an acoustic signal or vice versa (Stach, 1997: 72).

- **Output limiting**

This refers to the restriction of the maximum output of a hearing aid by peak clipping or amplitude compression (Stach, 1997: 155).

- **Prescriptive hearing aid fitting**

A strategy for fitting hearing aids by the calculation of the desired gain and frequency response, based on any of a number of formulas that incorporate pure-tone audiometric thresholds and may incorporate uncomfortable loudness information (Stach, 1997: 166).

- **Frequency response**

  Gain as a function of frequency for a given hearing loss (Snik & Stollman, 2000: 55).

1.5 SUMMARY

This chapter served as an introduction and motivated the importance of this study. It found its focus in the statement of the research problem based on a motivated rationale. It served to "hang a question mark" on the nature of EHI and support services provided to the paediatric population by South African audiologists. An outline was provided of the chapters of this thesis as well as a clarification of terms as they are applied in this study. This chapter concludes with the words of Gravel in the opening address at the third international conference: A sound foundation through early amplification 2004: "Let us remember that while partly art and partly wisdom honed by experience, the practice of paediatric audiology must always be a science."

CHAPTER 2

REVIEW OF THE EVIDENCE AND LITERATURE DEFINING INTERNATIONAL BEST PRACTICE IN EHI

Aim: To review the existing literature and evidence base defining international best practice guidelines in service provision to infants with hearing loss. To relate controversies, benefits and limitations in this field.

"The deepest sin against the human mind is to believe things without evidence"
Thomas H. Huxley (1825-1895)

2.1 INTRODUCTION

If one considers knowledge to be a circle, the area inside the circle would represent our current knowledge in any area while the periphery defines the unknown. The border of the periphery is always greater than the area within the circle, thus the unknown is always greater than the known. Furthermore, as the circle, representing the knowledge, increases, the periphery increases correspondingly, and so does the unknown. This example illustrates the continuing challenges professionals seem to face: When learning or doing something new, more questions than answers are often created. The first part of this challenge to audiologists providing EHI services, is to acquire the knowledge that is available through a considerable evidence base, and to use this evidence to guide service delivery (Bamford et al., 2000: 151). The purpose of this chapter is therefore to supply a historical overview of EHI and its importance, reviewing the existing evidence base and literature that define international best practice guidelines in service provision to infants with hearing loss. The second aim is to

discuss the factors influencing this service provision with specific emphasis on the unique challenges faced by the South African audiologist. This chapter will relate controversies, benefits and limitations in this field. The chapter will conclude with a summary of the benchmarks provided by international best practice guidelines gathered from the international evidence base. These benchmarks will be categorised using the six M variation categories as explained in chapter one. The following figure (figure 2.1) provides an outline of chapter two.

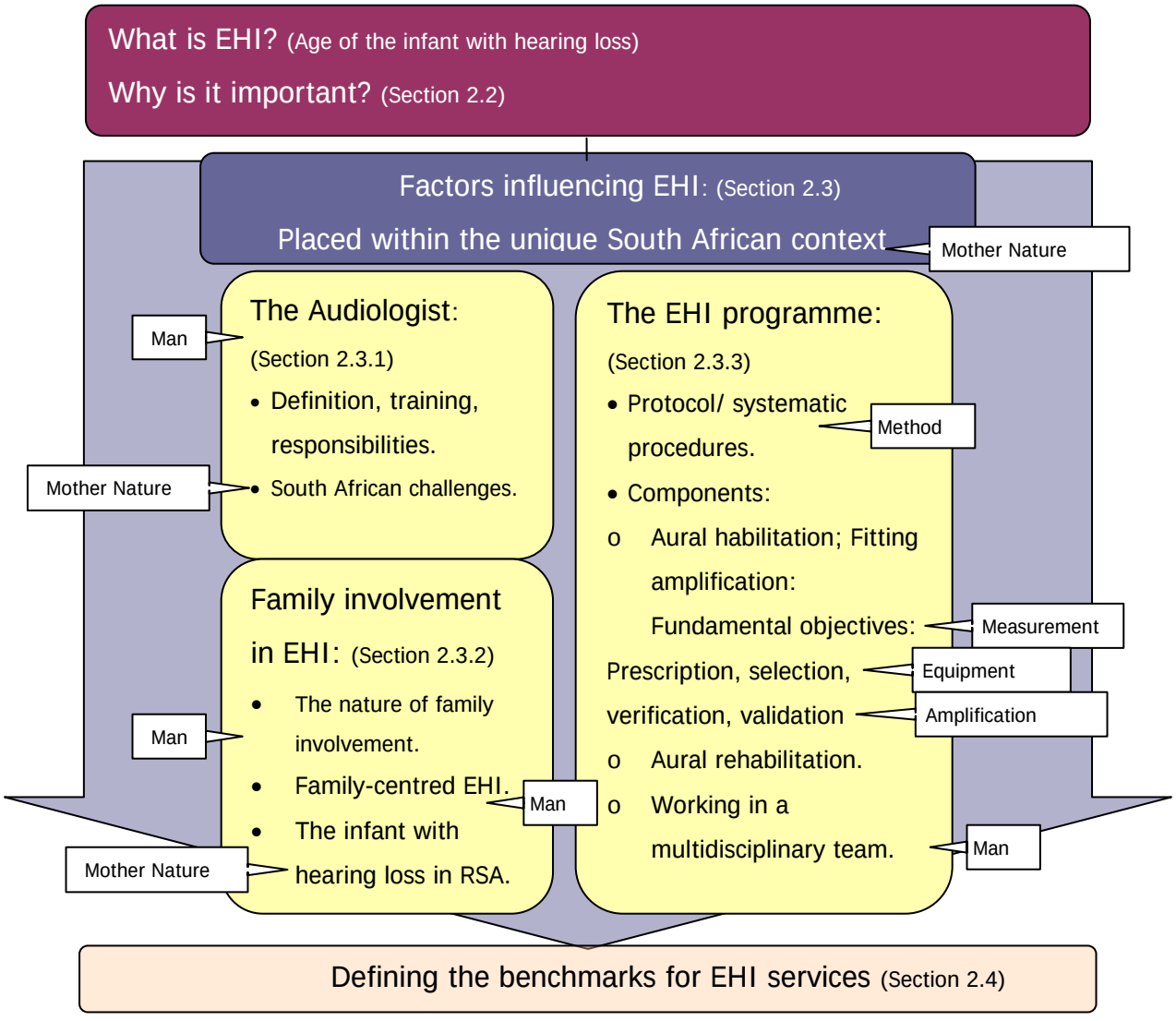


Figure 2.1 Outline of chapter two, with the factors to be discussed mapped to the six M variation categories

As demonstrated in figure 2.1 the importance of EHI will be motivated from the existing body of knowledge. Factors influencing EHI services will be discussed and placed within the South African context. These factors include the audiologists, the involvement of the family, as well the components of the EHI programme. Figure 2.1 also demonstrates how these factors can be categorised according to the six M variation categories. Review of the relevant literature and evidence will serve to define the international best practice benchmarks against which the EHI services can be evaluated. The benchmarks will be defined and categorised using the six M variation categories. The chapter will then be concluded and summarised.

2.2 EARLY HEARING INTERVENTION: HISTORICAL OVERVIEW, IMPORTANCE

It is almost self-evident in the field of education of infants with hearing loss that early detection and intervention will yield a better functioning child (Luterman, 1999: 35). This perception is supported by research dating back to 1947. Sir Alexander and Lady Irene Ewing describe their landmark approach to auditory training and communication development, a philosophy we now call “early intervention” (Seewald, 2002: v). It was reasoned by the Ewings that early amplification allowed an infant with hearing loss to maximise the use of auditory data to trigger an innate propensity for language learning (Bess, 2000: 247). Due to practical (physical weight 0.7 kg) and electroacoustic limitations of personal amplification devices, limited hearing aid use was recommended to children under five years (Ewing, 1947, as cited in Seewald, 2002: v). Yet they advocated use of residual hearing due to the great benefit derived from the regular use of hearing aids (Ewing, 1947, as cited in Seewald, 2002: v).

Early experience has proven to be critical for brain development and this evidence provides the force to ensure learning opportunities for all infants (JCIH, 2000: 17). Studies conducted on animals over the years suggested that there is considerable plasticity in the auditory pathway during early development but in the adult subject plasticity is greatly reduced (Harrison, 2002: 22). Clinically this data indicate that the early post natal period is very important for the establishment of auditory pathways that can accurately represent complex sounds at the cortical level (Harrison, 2002: 22). There appears to be a critical period of plasticity of the auditory system (Harrison, 2002: 22). The ability to hear is of special importance for infants' development as it is the key to the acquisition of spoken language (Fry, 1978, as cited in Boothroyd, 2000: 1). An early study by Greenstein (1975, as cited in Luterman, 1999: 35) concluded that children who were enrolled in early intervention programmes before 16 months showed greater language competency than their deaf peers who were enrolled after 16 months.

In recent years, new technologies and improvements to existing technologies that substantially enhance infant hearing assessment led to earlier identification of hearing loss in infants (JCIH, 1994: 39). In 1982 the Joint Committee on Infant Hearing (JCIH) recommended identification of infants at risk for hearing loss in terms of specific risk factors and suggested follow-up audiological evaluation until an accurate assessment of hearing could be made (JCIH, 1994: 38). In 1990 the list of risk factors were expanded and a specific hearing screening protocol was recommended (JCIH, 1994: 38). Risk factors screening however, identifies only 50% of infants with significant hearing loss (JCIH, 1994: 38). In 1993 the National Institutes of Health in the United States published the Proceedings of the Consensus Development Conference on the Early Identification of Hearing Impairment in Infants and Young Children (National Institutes of Health, 1993, as cited in Seewald, 2002: vi). A year later, in 1994, the JCIH released their position statement. Both documents endorsed the goal of *universal detection* of all infants with hearing loss as early as possible, preferably by three months of age (JCIH,

1994: 38-40, National Institutes of Health, 1993, as cited in Seewald, 2002: vi). These two documents are likely to be counted among the most significant publications in the history of paediatric audiology (Seewald, 2002: vii). These statements were endorsed by the American Academy of Pediatrics. The priority of universal detection of hearing loss as early as possible was in concert with the national initiative Healthy People 2000 as well as the American Academy of Audiology, all of whom supported the need to identify all infants with hearing loss (Seewald, 2002: vii).

The principles supplied by these documents led to research providing the evidence for newborn hearing screening. A study by Yoshinaga-Itano, Sedey, Coulter and Mehl (1998: 1161-1171) with a group of children whose hearing losses were identified and who received intervention by six months of age, demonstrated their significantly better receptive and expressive language skills than those of children whose hearing losses had been identified and who had received intervention after the age of six months. This language advantage was evident across age, gender, socio-economic status, ethnicity, cognitive status, degree of hearing loss, mode of communication and presence or absence of other disabilities (Yoshinaga-Itano et al., 1998: 1161). For the South African context with a high percentage of unemployment and poverty, the fact that the socio-economic status of the early identified infant is compensated for by early intervention services, is especially relevant (Yoshinaga-Itano, 2004: 457).

The findings of this study, among others, led to the endorsement of universal newborn hearing screening (UNHS), the *identification of hearing loss by three months and intervention for infants with hearing loss by six months of age* (JCIH, 2000: 10). As a result newborn hearing screening systems are now operating throughout North America, in many European countries, and on other continents (Brown, 2005: 185). In South Africa the Professional Board for Speech, Language and Hearing Professions of the HPCSA published the HSPS year 2002. In this South African document the eight principles as stated in the 2000 JCIH position

statement are accepted. As the goal of UNHS reaches beyond the borders of developed countries into developing countries (Mencher & DeVoe, 2001, as cited in Swanepoel, 2004: 99), providing true EHI to infants became a reality in South Africa.

UNHS provided audiologists with new opportunities, but also created new challenges - as the circle of knowledge widened, so did the periphery of uncertainties and questions. In October 2001, the United States Preventative Services Task Force (USPSTF) published a paper: "Recommendations and Rationale: Newborn Hearing Screening" (Thompson et al., 2001: 2001-2010). In this paper the USPSTF concludes that modern screening tests for hearing impairment can improve identification of newborns with permanent hearing loss (PHL), but that the efficacy of UNHS to improve long-term language outcomes remains uncertain. They state that although the hypothesis that early intervention is a predictor of language acquisition is plausible, the studies regarded as evidence for UNHS (including the Yoshinaga-Itano et al. study, 1998), are judged to have significant methodological flaws and do not establish that screening low-risk newborns are the important factor for improving language outcomes (Thompson et al., 2001: 2005). According to this paper none of the evidence investigated by them linked short-term improvements to better functioning later in life.

In a comprehensive reply to the USPSTF, Yoshinaga-Itano (2004: 451-465) defends the evidence supplied by the studies under scrutiny, and underlines the rationale for this current study: "Most professionals in communication disorders believe that the screening is not the actual cause of better developmental outcomes but that the age when children begin to have access to language and communication and *the characteristics of the intervention* are the primary cause of better outcomes. Screening is the avenue through which access to *quality early intervention* is made available" (Yoshinaga-Itano 2004: 451-452). She addresses the named methodological shortcomings described by the USPSTF (USPSTF 2001: 2001-2010) by describing the different levels of evidence needed for different

audiences (Yoshinaga-Itano, 2004: 451). According to her, the level of evidence required by medical/health agencies and task forces may differ from the level of evidence available in education and intervention. Issues related to the low incidence of the disability, the lack of normal distribution within the disability study, the obstacles to random assignment to treatment, and designs that include a control group with "no treatment", have legal and ethical implications for professionals providing EHI services to infants with hearing loss (Yoshinaga-Itano, 2004: 451). Her reply to the USPSTF's report is in concert with the reply of the American Speech-Language Hearing Association (ASHA) and the reply of the American Academy of Audiology (AAA) published on the World Wide Web in October 2001 (retrieved on July 20, 2005, from *http://www.audiologyonline.com/news/index.asp*). In their response ASHA write that although they are supportive of additional research in UNHS, randomised, controlled trial would not be feasible due to ethical considerations. ASHA's president, John Bernthal, writes: "The level of evidence the USPSTF is seeking is stringent, and leads one to question whether randomised studies on American children with hearing loss is ethically appropriate" (ASHA statement retrieved on July 20, 2005, from *http://www.audiologyonline.com/news/index.asp*).

The USPSTF report (Thompson et al., 2001: 2001-2010) and subsequent reactions serve to remind us that evidence-based practice involves clinical decision-making not based solely on the results of the literature review, but balanced by the consideration of three "truths" or realities about clinical practice (Gravel, 2005: 17). They are:

- practice should always be considered in view of the *needs, culture and preferences of the individual client*;
- there is a real probability that some of the *evidence base supporting current practice will change* or, indeed, be entirely refuted by evidence that will emerge in future;

- many “best” practices will never be evaluated by using the highest level of evidence-based studies (random control trails) because of the *ethical considerations* that would preclude such investigations (Feinstein & Horowitz, 1997, as cited in Gravel, 2005: 17-18).

These three realities are of special importance in our South African context where audiologists need to rely on evidence gathered from first world countries such as the USA, but serve infants with hearing loss in a unique third world context. The importance of continuously gathering evidence from our country and delivering services sensitive to the needs, culture and preferences of infants and their families in the South African context is crucial and underlines the motivation for this study. The South African government recognises this need for contextually relevant health research by stating that the most powerful and sustainable means of achieving this paradigm shift in advancing health is through the development of research capacity (Department of Health, 2001: 1). They motivate that applied research to determine the effectiveness and impact of programmes conducted in South Africa is needed to ensure that all South African citizens are provided with health services that are effective and efficient (Department of Health, 2001: 7).

To summarise this section it is clear that quality intervention services provided immediately upon early diagnosis of the hearing loss are, in all likelihood, the primary cause of better developmental outcomes (Yoshinaga-Itano, 2004: 454). Improvement in the quality of life of South African infants with hearing loss who receive timely and quality EHI is a reasonable assumption as higher language level is related to earlier identification and intervention and higher cognitive levels, better maternal bonding and children with higher language levels have better personal-social development (Yoshinaga-Itano, 2004: 463). Through revision of the controversies regarding the evidence for EHI, audiologists are reminded that continuous gathering of contextually relevant evidence is crucial for the rendering of relevant EHI services to South African infants with hearing loss.

From this discussion the undeniable importance of EHI is evident. Johnson and Danhauer (2002: 185) compare the EHI programme to a relay team. A relay team cannot be successful unless the final runner crosses the finish line. Similarly, EHDI programmes that effectively identify infants with hearing loss at birth are worthless unless those infants and their families are transferred to an effective family-centred early intervention programme (Johnson & Danhauer, 2002: 185). Several factors can influence the effectiveness of the EHI programme and will be discussed in the following section.

2.3 FACTORS INFLUENCING THE EHI PROGRAMME

Through review of the literature and available evidence base, it has been argued so far that EHI provided within a sensitive period of development can lead to improved developmental outcomes. Thus it is essential to study and control the following variables that might have an influence on the quality of the EHI services provided to South African infants with hearing loss and their families:

- the *knowledge*, *skills and expertise* of the *audiologists* providing the EHI services, and the *unique challen*ges of South African audiologists;

- the *infant with hearing loss* and the nature of the involvement of his or her *family,* within the unique *South African context;*

- the *EHI programme* (protocol/ systematic procedures used, components, fundamental objectives).

These factors will be elucidated in the following sections.

2.3.1 The audiologist

The focus of the current study is to describe the nature of EHI services rendered to infants with hearing loss by South African audiologists. The practice behaviour of the audiologist is under scrutiny. Subsequently the roles and responsibilities of audiologists in EHI will be discussed. The unique challenges posed to South African audiologists in fulfilling these responsibilities will be highlighted thereafter.

2.3.1.1 Definition, training and responsibilities of the audiologist

The profession of audiology started after the Second World War when it was recognised that many of the returning veterans had sustained hearing losses. The combination of otology and speech pathology services at the Deshon Army Hospital gave birth to the profession of audiology in the presence of Dr Raymond Carhart (Ross, 1997, as cited in Luterman, 1999: 12). Audiology was at first devoted to adult rehabilitation, but then moved to testing and prescription of amplification for children (Ross, 1992, as cited in Luterman, 1999: 12). Now there was a professional who was concerned with the detection of hearing loss and the use of residual hearing in the habilitation of children with hearing loss. The American Speech-Language-Hearing Association (ASLHA) defines audiologists as "professionals engaged in autonomous practice to promote healthy hearing, communication competency, and quality of life for persons of all ages through the prevention, identification, assessment, and rehabilitation of hearing, auditory function, balance, and other related systems" (ASLHA, 2004: 3).

Clearly the role of the audiologists in the identification, management and support of children with hearing loss has changed dramatically since it started in 1945. With the age of identification of hearing loss rapidly diminishing, paediatric audiologists are faced with the responsibility of providing EHI services to very

young infants diagnosed with hearing loss. In 1978 Quigley (as cited in Oyler & Matkin, 1987: 27) predicted that the audiologist is likely to become the key person in the early education of the child with hearing loss. Although this may be an overstatement, as no one professional or discipline can meet the diverse and complex needs of infants with hearing loss and their families (Diefendorf, 1996: 135), it is apparent that audiologists need to be knowledgeable in areas including speech-language development and consequences of hearing loss upon intellectual, social and emotional development (Oyler & Matkin, 1987: 27). The question asked by Johnson and Danhauer (2002: 203) is how knowledgeable is knowledgeable enough.

Training of audiologists is seen as fundamental in providing the knowledge necessary for the rendering of quality early intervention and support services to children with hearing loss. While EHI programmes are the result of extensive team work, their ultimate success depends upon the audiologists who are well prepared to provide EHI services to infants with hearing loss and to counsel the families of these infants (Oyler & Matkin, 1987: 27). It is the goal of training programmes to prepare audiologists to supply intervention services to infants with hearing loss that incorporate state-of-the-art technology and evidence-based protocols (Bess, 2000: 249).

Improvement of the *training of audiologist* seems like an obvious way to influence practice behaviour and is echoed in the conclusion from a national survey of educational preparation in paediatric audiology conducted in the USA by Oyler and Matkin (1987: 27-33). It emphasises the importance of the suggestion that Bess (2000: 249) makes regarding the improvements of the educational training programme. It reads: "... to reduce the impact of the hearing loss both upon the family of the hearing-impaired child and upon the child's language acquisition, academic achievement, and ultimately, vocational choices and success, it is apparent that many audiologists need to be better prepared to serve the pediatric

population…many programmes are failing to prepare their graduates adequately" (Oyler & Matkin, 1987: 27). It is recognised that the playfield for audiologists providing services to infants with hearing loss has changed dramatically in the almost 20 years since the survey was conducted. Nonetheless, it should be acknowledged that the rapidly advancing technology necessitates a strong basic education of the audiologists in conjunction with research (Gravel, 2005: 17). Historically, audiologists have not sufficiently subjected their diagnostic and rehabilitative protocols to scientific inquiry and scrutiny, thereby "flirting" with ethical issues (Frattali, 1996, as cited in Johnson & Danhauer, 2002: 20). The profession, training programmes, and practitioners share the responsibility of outcomes measurements for the future viability of audiology (Johnson & Danhauer, 2002: 20).

From the discussion so far, it is evident that audiologists should participate in outcomes measurement in all areas of practice. An understanding of the responsibilities of the audiologists in the EHI programme will help define these areas where outcomes measurements are needed, and assist in guiding clinical practice.

As experts in identification, evaluation, auditory habilitation and rehabilitation of infants with hearing loss, audiologists are involved in each component of the EHDI programme (JCIH, 2000: 13). According to the 2000 Position Statement of the JCIH (2000:13) audiologists are responsible for providing timely fitting and monitoring of amplification (sensory devices and assistive technology) to infants with hearing loss, with family consent, family education, counselling and ongoing participation in the infant's service plan. In addition audiologists are responsible for providing direct auditory habilitation services to infants and families and they should participate in the assessment of candidacy for cochlear implantation (JCIH, 2000: 18).

Apart from all the critical responsibilities of the audiologist, the fitting of appropriate amplification to infants is considered one of the more important responsibilities of the paediatric audiologist (The Pediatric Working Group, 1996: 53-68). To perform this function capably, The Pediatric Working Group recommends that an audiologist should have experience with the assessment and management of infants with hearing loss and the commensurate knowledge and test equipment necessary for use with current paediatric hearing assessment methods and hearing aids selection and evaluation procedures (The Pediatric Working Group, 1996: 53).

The advanced technology and clinical research that have evolved over the past 35 years have led to development of vastly improved methods for the identification of hearing loss, the audiological assessment of infants, the selection and verification of electroacoustic characteristics of hearing aids and the validation of aided auditory function (Bess, 2001: 248). Given these many improvements, one would assume that today's infants with hearing loss are benefiting from this new technology and the most recent evidence-based practices. Unfortunately, research has shown that such is not always the case. A survey concerning the practice behaviours of paediatric audiologists in the USA reveals that many audiologists do not use the available technology and evidence-based practices for the fitting of appropriate amplification to infants and young children (Hedley-Williams et al., 1996: 107-122). Hedley-Williams, Tharpe and Bess (1996: 120) demonstrated from a large survey of paediatric audiologists that no systematic, evidence-based procedure exists for the selection and fitting of hearing aids to young children. Although a follow-up amplification survey conducted in 2000 (Tharpe, 2000: 175-190) showed some increase in the proportion of audiologists using evidence-based paediatric hearing aid fitting procedures, there was still reluctance among clinicians to change their practices (Bess, 2000: 248). A survey study by Bamford and colleagues (2001: 329-338) in which performance of paediatric audiology services in the UK was assessed against existing good practice guidelines (NDCS,

1994 & 1996, as cited in Bamford, 2000: 329), came to the same conclusion: Widespread variability in quality of EHI services, and the consequent lack of equity in service provision to infants with hearing loss by audiologists. There may be several reasons for these findings. Hedley-Williams and colleagues (1996: 120) supply the following reasons:

- firstly, reports of research findings may not be reaching the clinical professionals;
- secondly, audiologists may be aware of these findings but may not have access to the equipment to conduct these procedures;
- thirdly, clinicians may be aware of the research findings but may find that these procedures are not as easy or effective as they appear in the literature and subsequently reject them (Williams, Tharpe & Bess, 1996: 120).

It is clear from results discussed in the previous paragraphs that audiologists in studies conducted in the UK and USA are often failing to incorporate state-of-the-art technology and evidence-based protocols. If this is true for audiologists in developed countries, it is possibly also true for audiologists in South Africa, a developing country. In order to understand the unique challenges posed to South African audiologists, the nature of the health care system in South Africa will be discussed in the following section.

2.3.1.2 The unique challenges posed to the South African audiologist

The healthcare system in South Africa of which audiology forms part, is in a process of transformation, much of which is a reflection of the changing South African environment. The healthcare system in South Africa has a dualistic nature. On the one hand there is the public health sector that is administered by the

government, and on the other hand there is a private sector that is administered and owned by private practitioners (Petros, 2001). The vast majority of audiologists are in private practice and provide services to a small minority of the country - primarily to people from developed context who can afford the services (Swanepoel, 2004: 131).

According to Statistics South Africa (2000, as cited in Petros, 2001:6), up to 40% of all South Africans live in poverty and 75% of the 40% live in rural areas where they are deprived of access to health services. The main core of the government's health policy is eventually to provide health care that is affordable and accessible to all as specified in the Integrated National Disability Strategy (Government Gazette, 1997, as cited in Petros 2001: 6). State hospitals are often handicapped by lack of financial resources, lack of equipment and personnel shortages, which have a direct impact on the level of service to patients (Department of Health, 2001, 2). These hardships have a direct impact on the economic reimbursement of the practitioner, in this case the audiologists, and directly impact on the recruitment and retention of these practitioners (Broffman, 1995: 819). In South Africa audiologists prefer not to take up positions in national health care because of a more lucrative market in the private sector (Swanepoel, 2004: 131). This leaves the national health system under-resourced and further emphasises the inequity created because of the diversity in the health care system.

In 2002 the HPCSA implemented a community service year for all speech-language therapy and audiology graduate students to respond to the escalating need for community-based EHI programmes (HPSCA, 2002b:7). Although there are still many challenges in terms of equipment and disposable shortages, this initiative is a step towards more community-based audiology services (Swanepoel, 2004: 129).

Another challenge posed to the South African audiologists is the multicultural and multilingual nature of the country. Although poverty is not confined to one racial group in South Africa, it is concentrated among blacks who constitute approximately 80% of the total population of South Africa, speaking one of the nine official black languages of South Africa (Swanepoel, 2004: 118). The minority of people in South Africa are mother-tongue speakers of English and Afrikaans, and so far only a small percentage of mother-tongue speakers of an African language have qualified as audiologists (Uys & Hugo, 1997: 24). Thus, the majority of the infants who will receive EHI services from audiologists in government clinics or hospitals will not speak the same language or have the same culture as the audiologists who will supply EHI services to these infants and their families. These multilingual and multicultural characteristics of the South African population create a unique challenge for the South African audiologists. The goal of providing information to parents in their preferred language as set by the NDCS in their Quality Standards in the Early Years (2002: 28) creates a very real challenge to South African audiologists.

Audiological training and services in South Africa have always incorporated and used international research to guide service delivery to infants and children (Swanepoel, 2004: 133). This is in accordance with the objective stated in the 2003 mission statement of the Professional Board of Speech, Language and Hearing Professions of South Africa to set a new professional practice framework in place, aligned with international professional best practices (HPCSA, 2003: 1). Yet, the unique challenges of South African audiologists necessitate the need for local research to acquire evidence that can provide guidelines for the implementing of contextually relevant, high quality EHI services. The Department of Health (2001: 5) underlines the importance of health research by:

- encouraging the uptake of research-based knowledge into the health care system;

- stating that the dynamic and changing nature of health situations necessitates that iteration and flexibility be built into the process through periodic monitoring and review of the programmes;
- concluding that the most powerful and sustainable means of achieving a paradigm shift in advancing health and development is through the development of the research capacity of South Africa.

To bring about the necessary changes in EHI services in South Africa, context-specific research initiatives are needed (Gopal, 2001, as cited in Swanepoel, 2004: 134). This supplies a very important and fundamental motivation for the current research study. By describing and evaluating the nature and scope of EHI and support services rendered to infants with hearing loss in South Africa important characteristics of the process can be defined and described. This information can ultimately lead to the development of guidelines that is aligned with international best practice and is also contextually relevant for the South African context.

The diversity of the country affects the working environment of the audiologists in South Africa, creating barriers to services delivering for some infants with hearing loss and their families. These barriers can be defined as factors that lead to the inability of the system to accommodate diversity and prevent learners to access these services (Department of Education, 2002: 131). The barriers created by the under-resourced national health care system in which realm some audiologists function, have been discussed in the section so far. In the next section the unique characteristics of the South African infant with hearing loss and his/ her family will be discussed.

2.3.2 Family-centred EHI services

The importance of the family in the intervention process has been accepted for many years. In 1975 McCormick wrote: “The family has the most direct influence

on any child during his early years, and we need to therefore direct our resources to parents if we are to influence the child through his waking hours, rather than just for an hour's duration of our visit" (McCormick, 1975, in NDCS, 2002: 7). The family-centred service model has its foundation in a US federally mandated plan, first defined in 1986 by Public Law 99-457 (Diefendorf, 1996: 134). In 1990 this law was replaced by the Individuals with Disabilities Act (IDEA), with Part H Public Law 102-119 the 1997 version (Diefendorf, 1996: 134). This act requires a multidisciplinary evaluation to determine eligibility and to assist in developing an individualised family service plan (IFSP) to describe the early intervention programme. The IFSP embodies a promise to children and families, a "promise that their strengths will be recognised and built on, that their beliefs and values will be respected, that their choices will be honoured, and their hopes and aspirations will be encouraged and enabled" (McGonigel & Johnson, 1991, as cited in Diefendorf, 1996: 134).

Effective hearing intervention should be sensitive to the specific desires of families for the intervention of their infant with hearing loss as well as the social-emotional issues surrounding the identification of their child's hearing loss (Seewald, 1999: 211). Left unaddressed these issues can be hindering the timely provision of intervention service. In the following sections the nature of family involvement in the EHI programme will be discussed. Thereafter factors specific to infants with hearing loss in South Africa and their families will be highlighted.

2.3.2.1 The nature of family involvement in EHI

In the EHI programme family involvement has been found to be highly predictive of better language development (Yoshinaga-Itano, 2002: 229). The importance of the family is undeniable and also true in the South African context. The question is however, in a diverse country and within an ever-changing society, how do we

define a family? The Longman Family Dictionary defines a family as: “a group of people living under one roof” (Longman Family Dictionary, 1984: 246). Another definition by Mary Richmond, considered by many as the founder of social work, is “those who eat at a common table” (Roush, 2000: 159). Bernheimer, Galimore and Weisner (as cited in Diefendorf et al., 1996:132) stress the importance of embracing what they refer to as an eco-cultural theory as framework for designing intervention for children with disabilities. Eco-cultural theory refers to consideration of the socio-cultural environment of the child and family (Diefendorf et al., 1996: 132). Professionals working with children in the first three years of life should be sensitive to whoever makes up the child’s family social support network, whoever eats at the child’s table.

For the South African society it is particularly important that the definition of the family should go beyond the traditional family and should include primary caregivers and others who assume important roles in the child’s daily life such as grandparents, cousins who live in the same house, trusted neighbours or long-time caregivers. In South Africa’s rural communities the grandmother tends to be the caretaker (Hugo, 1990: 6). The generation gap between the grandmother and child might be great placing additional strain on the family of the infant with hearing loss (Hugo, 1990: 6).

Accepting each family’s diversity, the strengths and competencies within the family can be drawn upon and a support network between the family and audiologists can be established (Diefendorf et al., 1996: 133). What affects one family member affects all family members (Rushmer, 1994: 160). The diagnosis of the hearing loss and subsequent EHI will affect the whole family. At this point the child does not have the problem - the parent[5] does (Luterman, 1999: 55). Not

[5] For the purpose of this study the term parents will refer to the significant primary caregivers of the infant with hearing loss.

only do parents and families have the right to expect services to offer a standard of care that reflects current evidence-based knowledge, but a recent study by Davis and Hind (2000, as cited in Bamford et al., 2000: 157) suggested an association between the quality of family life, and the parents' satisfaction with the EHI services. Services should be responsive to the needs of every child with hearing loss and his/ her family if the support provided is to be effective.

Although it seems that most professionals believe in a family-centred approach, they seem to vary widely in their application of family-centred principles. In a survey conducted by Roush, Harrison and Palsha (1991: 360-366), the respondents, who were all professionals working with infants with hearing loss, indicated that they place a high value on the desirability of family-centred intervention. However, from the survey results it seemed that they were reluctant to defer to family priorities when there was a discrepancy between professional and parent priorities (Roush et al., 1991: 365). In a follow-up study (Roush, 2000: 161) 400 parents were surveyed in order to seek advice from them regarding EHI and support services. The most frequently cited priorities were:

- the need for audiologists to offer information about intervention options available;
- information about hearing aid care and maintenance;
- written information;
- avoidance of professional jargon when explaining technical matters and test results;
- information about and referrals to services available in their communities;
- honest and helpful appraisal of the child's prognosis;
- need for professionals to recognise the emotional upheaval of the diagnosis and support families in their grieving process (Roush, 2000: 162).

These findings correlate well with results from a survey by the NDCS in the UK in 1999 (as cited in NDCS, 2002: 6). Results indicated that two of the most

important issues arising were that families want unbiased information and qualified, experienced professionals who respect them and their child (NDCS, 2002: 6). Families should deal with the emotional impact of the diagnosis as well as the day-to-day care of the infant (Elfenbein, 2000: 147). From these mentioned priorities it is apparent that counselling and instructional strategies should be selected to meet the individual needs and desires of the family members.

From the discussion above it is obvious that family goals should drive the EHI programme. Parents need to know that the audiologist working with them will support them in their decisions, even if the professionals do not agree with the decisions. Parents need to find the best solutions for themselves - no educational method is going to work unless parents freely choose it and take responsibility for it (Luterman, 1999: 31). Intervention should be provided in such a way as not to de-skill parents (Bamford, 2000: 360). Parents should be empowered to make decisions that they believe are right for the infant with hearing loss and their family. Empowerment is both a process and an outcome that takes different forms in different families (Diefendorf et al., 1996: 133). Empowering families for EHI does not mean giving power to them - the power is theirs by right. Rather, it means interacting with families in such a way that they maintain or acquire a sense of control over their daily family life and attribute positive changes that result from EHI to their own strengths, abilities and actions (Dunst, Trivette & Deal, 1988, as cited in Diefendorf, 1996: 133).

The principles central to family-centred EHI programmes, as discussed in the section so far, will be uniquely influenced by the South African context. In the next section the infants with hearing loss and his/ her family will be placed within the South African context.

2.3.2.2 The infant with hearing loss and his/her family in South Africa

It is reported that approximately one in every 20 people in South Africa is disabled (Central Statistics, 1998: 38). Hearing loss is reported to comprise approximately 22% of disabilities in South African children. An additional four per cent have multiple disabilities of which hearing loss probably constitutes an additional number of cases (Statistics South Africa, 1999: 15). Historically, the vast majority of people with disabilities in South Africa have been excluded from education, information and community life (SAHRC, 2002: 13). South Africa's progressive constitution of 1996 is founded on the values of human dignity, equality and freedom. The Bill of Rights specifically mentions equality and non-discrimination for persons with disabilities (SAHRC, 2002: 13). Inequalities in the society such as urban/ rural disparities lead to inadequacies in service provision to infants with hearing loss in South Africa (Department of Education, 1997: 12). Barriers result not only from the inadequacy of provision, but also from practices which are designed to perpetuate these inequalities. Some of these barriers will be highlighted in the following section.

- One of the most significant barriers to the rendering of EHI services remains the inability of infants with hearing loss to *access* these services. In most instances this inability results from inadequate or non-existent services and facilities (Department of Education, 1997: 12). The lack of access to services might also be contributed to financial constraints of the family of the infant with hearing loss. Generally, these inadequacies in provision are linked to other inequalities in the society such as urban/ rural disparities. For example, infants with hearing loss and their families might be unable to reach clinics or practices where EHI services are provided because there are no transport facilities available or the roads are so poorly developed and maintained that these clinics cannot be reached (Department of Education, 1997: 12). The fact that EHI services are thus not easily accessible might hinder the timely fitting

of amplification, as well as frequent follow-up visits to monitor audiological findings and hearing aid fittings.

- The most obvious effect of *financial constraints* on the family of the infant with hearing loss is the inability of families to meet the intervention needs of the infant with hearing loss. Extreme income inequality is evident in the form of poverty side by side with affluence (Swanepoel, 2004: 118). In South Africa unemployment is a reality resulting in poverty affecting almost 50% of South Africa's population, which results in the family not being able to meet even the basic needs of the infant such as nutrition and shelter (Department of Education, 1997: 13). Socio-economic pressures on families of infants with hearing loss for example result in a priority shift within the family from attending to the rehabilitation of a disability to dealing with more basic needs of nutrition. Even if intervention can be supplied at no cost and hearing aids are subsidised by the government, maintenance of the hearing aids (such as battery replacements) might be impossible for the parents to afford. As a result of the financial difficulties of the families of infants with hearing loss, amplification choices are limited and advances in technology become a theoretical possibility. Financial constraints or, in its extreme form poverty, of the family of the infant with hearing loss, is an ever-present barrier that will impede the delivery of EHI and support services to the majority of South Africans and should therefore be carefully considered for future implementation of these services.

- *Negative and harmful attitudes towards differences in our society* remain a critical barrier to development. In some rural communities a disabled child is held to represent the family's social position and is often regarded with shame (Hugo, 1990: 5). This attitude may also be transferred to the EHI programme and hamper parent involvement in the EHI process. The active involvement of parents and the broader community in the learning process is central to

effective development of the infant with hearing loss (Department of Education, 1997: 18). The lack of parental involvement in EHI centres might also be due to negative attitudes towards parental involvement, lack of resources to facilitate such involvement, lack of parent empowerment and support for parent organisations (Department of Education, 1997: 18).

- A final phenomenon unique to the rural South African family, is the *group solidarity*, characterised by the interdependence of the various members (Hugo, 1990: 5). This solidarity is founded in the philosophy of ubuntu. Ubuntu philosophy holds that all people should be treated with respect and dignity, because a person becomes a person through other people. (Louw, 2005: 1). Unfortunately the philosophy of ubuntu might also create a unique barrier to the rendering of EHI services to infants with hearing loss. Enrolment of the infant in an EHI programme might have financial implications for the whole community and might as a result be declined as it might not be in the best interest of the group as a whole. Education into the long-term effects of the hearing loss on language development of the child and subsequently on later vocational outcomes is thus essential.

Central to the development of high quality EHI programmes is the identification of these factors that influence the provision of EHI and support services. The aim of this section was to describe the unique factors characterising and influencing the infant with hearing loss and his/ her family in South Africa. The final variable that might have an influence on the quality of the EHI services provided to South African infants with hearing loss and their families is the EHI programme.

2.3.3 The EHI programme

In the development of an EHI programme the focus should be on quality provision and quality assurance guidelines (Bamford et al., 2002: 213). Thus consensus statements, guidelines, standards and protocols are essential to guide the development of an EHI programme (Bamford et al., 2002: 213). There is very little evidence for the efficacy of specific characteristics of the intervention provided (Yoshinaga-Itano, 2004: 452). Therefore the researcher will rely mostly on existing guidelines (e.g. The Pediatric Working Group, 1996, and NDCS Quality Standards in Paediatric Audiology, 2000, and NDCS Quality Standards in the Early Years, 2002), consensus statements (e.g. JCIH, 1994 and 2000) and protocols (e.g. AAA Pediatric Amplification Protocol, 2003), as recommended by Bamford et al. (2002: 213), when discussing factors important for a quality EHI programme.

In the JCIH position statement (1994) the following is stated as components of the EHI programme (pp. 38-41):

- family support and information regarding hearing loss and the range of available communication and intervention options;
- implementation of learning environments and services designed according to the family's preference;
- early intervention activities that promote the child's development in all areas, with particular attention to language acquisition and communication skills;
- early intervention services that provide ongoing monitoring of the child's medical and hearing status, amplification needs, and development of communication skills;
- curriculum planning that integrates and coordinates multidisciplinary personnel and resources so that intended outcomes of the IFSP are achieved.

The components regarding the family (first two bullets) have been discussed in section 2.3.2. In the following section early intervention activities promoting the

child's development with particular attention to language acquisition and communication skills, as well as the monitoring thereof, will be discussed. Finally the nature of the multidisciplinary team will be highlighted.

2.3.3.1 Intervention activities

The infant's language and communication development is dependent on quality intervention services provided immediately upon early diagnosis of the hearing loss (Yoshinaga-Itano, 2004: 454). Optimal intervention strategies for the infant with hearing loss require that intervention begins as soon as there is confirmation of a permanent hearing loss to enhance the child's acquisition of developmentally appropriate language skills (JCIH, 2000:17). The vast majority of infants and children with bilateral hearing loss benefit from some form of personal amplification (The Pediatric Working Group, 1996: 54). "The audiologist is the professional singularly qualified to select and fit all forms of amplification for children" (The Pediatric Working Group, 1996:53). In the next section the fitting of amplification to infants with hearing loss will be discussed. As the fitting of appropriate amplification to infants is considered one of the more important responsibilities of the paediatric audiologist (The Pediatric Working Group, 1996: 53-68) and advances in technology have greatly influenced this task, emphasis will be placed on this habilitation strategy. The acquisition of language and communication competence is another primary focus of EHI programmes (JCIH, 2000: 18) and intervention activities focusing on rehabilitation strategies will be discussed lastly.

2.3.3.1.1 Amplification

For almost all children with permanent sensory-neural hearing loss initiation of intervention begins with hearing aid fitting (Yoshinaga-Itano, 2004: 453). The

Pediatric Working Group on Amplification for Infants and Young Children (Bess et al., 1996: 54) recommended that a young child with permanent bilateral hearing loss of 25dB HL or greater in the 1000 to 4000Hz range should be considered a candidate for amplification. This degree of permanent childhood hearing loss (PCHL) was deemed to be potentially deleterious for the perception of acoustic speech features necessary for the development of typical aural/oral communication. The Pediatric Working Group (1996) also suggested that young children with unilateral hearing loss, rising or high frequency hearing loss above 2000 Hz, or hearing loss milder than 25 dB might also benefit from amplification technology, and that need should be based on the audiogram plus any additional information such as cognitive function, other disabilities and the child's overall performance at home (The Pediatric Working Group, 1996: 53). In an adult a mild degree of hearing loss (25dB to 40dB HL) would not necessarily result in a communication disability. Nozza (1994: 285-298) has however suggested that even in quiet listening conditions a mild hearing loss is likely to be deleterious to an infant's ability to discriminate speech sounds. Therefore the existence of any degree of PCHL in infancy could jeopardise the young child's acquisition of aural/ oral language.

Three *fundamental objectives* when fitting hearing aids to infants are to ensure consistent audibility and hearing aid performance over time, to ensure audibility of the speech input and to verify that sounds are not uncomfortably loud (Kuk & Marcoux, 2002: 504). These three factors are fundamental for the development of speech and language abilities in children and will be discussed in the following section. It has often and in many contexts been said that children are not just little adults. When fitting hearing aids to infants this is a fundamental truth. Some of the known differences between children and adults as related to hearing aid fittings include (Palmer, 2005:14):

- the amount of audiological information - often with children limited information is available;

- the variety of audiological configurations in children – it is estimated that there is more variation in children's audiogram configurations ;
- the physical size of the ear canal – smaller for children than adults;
- the changing size of the ear canal – and subsequent differences in some measurements such as sound pressure level at the eardrum;
- the need to pre-programme the hearing aids in a coupler because of infant/ toddler movement or vocalisations that might prohibit real ear measurement;
- the lack of feedback from the infant.

In the following section the fundamental objectives, as named in the previous paragraph, will be discussed and differences in the clinical fitting of infants will be considered and highlighted.

- *Fundamental objective one*: Consistent audibility

Consistency of the signal is especially important as young children do not have the ability to fill in the missing speech sounds (Boothroyd, 1990, as cited in Kuk & Marcoux, 2002: 504). Speech sounds that are not heard, or are heard intermittently, may not be produced accurately and production might consequently be delayed (Kuk, 1999, as cited in Kuk & Marcoux, 2002: 504). Adults depend on context to fill in gaps in audibility, but children with their limited experience in oral communication, are unable to do that. In fact, The Pediatric Working Group (1996: 58) states: "It is likely that normal development of speech perception, speech production, and language may depend on acoustic factors not critical for communication in listeners who already have normal language skills."

The first factor to ensure consistent input for the paediatric patient with bilateral hearing loss is the consistent use of binaural hearing aids (Kuk & Marcoux, 2002: 505). The binaural hearing system plays an important role in abilities such as the localisation of sound, understanding speech in noise and suppressing echoes (Litovsky, 2002: 25). Children learn from hearing sounds, both speech and non-

speech sounds, from their auditory environments. Aiding the child monaurally in the presence of a bilateral hearing loss could delay the auditory developments and speech-language skills of the child as well as the child's social and academic progress (Kuk & Marcoux, 2002: 505). In addition investigations have reported auditory deprivation in children fitted with unilateral amplification (Boothroyd, 1993: 336). Finally, the safety of the child may be jeopardised when warning signals presented on the unaided side are missed (Kuk & Marcoux, 2002: 505). The Pediatric Amplification Protocol (AAA, 2003:1-23) recommends that, unless contraindicated, children be fitted with bilateral amplification. According to the Quality Standards in Paediatric Audiology (NDCS 2000: 14) infants with hearing loss and no medical contraindication should begin use of amplification when appropriate and agreed upon by the family within one month of confirmation of the hearing loss.

- *Fundamental objective two*: Audibility of the speech input

Audibility of the speech input is undoubtedly a fundamental objective when fitting infants with hearing aids (Ching et al., 2002: 141; Kuk & Marcoux, 2002: 504). Speech cannot be understood if it cannot be heard. Therefore ensuring *optimum gain at all input levels* is an essential characteristic needed of the amplification fitted to the infant with hearing loss. There is however no clear-cut recommendation on the precise gain that should be prescribed for children (Snik & Stollman, 2000: 55). Studies have indicated that young children with normal hearing need higher intensity levels to be able to discriminate speech sounds as well as adults can (Nozza, Rossman & Bond, 1991: 102-112). In this regard the difference between adults and infants in respect of the proximity of the child and the speaker is pointed out by Stelmachowicz et al. (1993: 618). They found that the input levels to the infant's hearing aid microphone are much higher (as much as 20dB) than that of an adult in normal conversation, because of the way the parent holds the child.

Furthermore it is not known whether the *optimal frequency response*[6] in children who are still at the beginning of their speech-language development is the same as that in children who have acquired some language (Snik & Stollman, 2000: 55). There are also many questions regarding the *low as well as high frequency amplification needs* of children. Some studies have suggested that the provision of high-frequency amplification may not always be beneficial and can even degrade speech perception for some individuals (Ching, Dillon & Katsch, 2002: 141-152; Moore, 2002: 160). In these studies there is considerable variability in performance among individuals and no consensus has been reached on the degree of hearing loss at which benefit from high frequency amplification no longer occurs (Moore, 2002: 160). Ching, Dillon and Katsch (2002: 141-152) indicate that there is no conclusive evidence available at this point and time. The Paediatric Amplification Protocol (AAA, 2003: 6) echoes these findings and urges the clinician to consider each child as an individual as more evidence is awaited in this area. With regard to low-frequency amplification it appears that infants require access to low-frequency sounds to facilitate the early use of intonation (Buerkli-Halevy & Checkley, 2000: 77). Low-frequency information plays a significant role in the early communication of infants (Clarkson & Roger, 1995, as cited in Buerkli-Halevy & Checkley, 2000: 78).

- *Fundamental objective three*: Verification of uncomfortable loudness levels (UCL)

The limited maximum output of the hearing instrument is often referred to as the saturation sound pressure level (SSPL). If the SSPL is set too low by the output compression amplified, normal speech may be distorted and therefore less recognisable (Snik & Stollman, 2000: 56). If, on the other hand, the SSPL is set

[6] Frequency response is defined as an output characteristic of the hearing aid, expressed as gain as a function of frequency (Stach, 1997: 46).

too high, loud sounds may cause discomfort and there is the risk of damaging the patient's residual hearing (Macrae, 1994, as cited in Snik & Stollman, 2000: 56). In young children with small ear canals, the SSPL measure in the ear canal will be considerable higher than that of adults (Seewald, 1995: 3). According to The Pediatric Working Group (1996: 55) setting the output-limiting characteristics of hearing aids for children is considered of equal, if not greater, importance than the other amplification considerations.

Ideally, audiologists should consider both safety and comfort in selecting the hearing aid's maximum output (Palmer, 2005:10). To this end, the audiologists should know what output levels exist in the ear canal of the infant (The Pediatric Working Group, 1996: 55). Recommendations regarding the measurement of output levels in the infant's ear canal will be discussed in the sections on verification of the fitting to follow. The unique acoustic properties of the infant's external ear canal necessitate the use of a systematic objective approach that incorporates age-dependant variables into the computation (The Pediatric Working Group, 1996: 55). With very young children it is impossible to get a reliable, valid measure of comfort. Therefore, we have to depend on predicted levels for setting output limiting for safety and comfort (Palmer, 2005:10). Kawell et al. (1988: 136) reported that loudness discomfort levels in children were similar to those of adults, which supports using predicted UCL values when fitting children. Finally, as the infant's ear canal grows, electroacoustic requirements will change and there might be a need for higher output capability (Roush, 2005: 108).

In summary, the goal is to ensure that children will receive full-time and consistent audibility of the speech signal at safe and comfortable listening levels (The Pediatric Working Group, 1996: 53). In some cases infants who have been fitted with appropriate hearing aids might have limited aided auditory capacity and cochlear implants should be considered (Boothroyd, 2000: 6). Identification of hearing loss through newborn hearing screening will mean that cochlear implants

can be considered sooner for children whose aided auditory capacity is small. The decision to implant will of course be based on numerous factors in addition to the hearing loss (Boothroyd, 2000: 6). Parents should be informed and referred to specialised team members (NDCS, 2002: 16).

For the provision of appropriate, reliable and undistorted amplification for infants with hearing loss, the general is that there should be a relationship between the auditory characteristics of infants and the characteristics of amplification (Seewald & Scollie, 1999: 64). Consequently it is necessary to ensure the validity of the audiometric data, since they will serve as the foundation upon which the electroacoustic selection is developed (Seewald & Scollie, 1999: 64). The efficacy of the hearing aid fitting is predicated on the validity of the audiological assessment (The Pediatric Working Group, 1996: 54). As this study focuses on the services rendered to the paediatric population after the confirmation of hearing loss, the audiological assessment stage of hearing aid provision will not be discussed in detail. The importance of having accurate hearing thresholds prior to fitting hearing aids to infants is acknowledged, as an error in threshold estimate will lead to wrong assignment of gain (Kuk & Marcoux, 2002: 504). The JCIH (2000: 10) recommends that infants with amplification receive ongoing audiological monitoring at intervals not exceeding three months and the fitting of the amplification should be adjusted based on the updated audiometric information.

In order to reach these three fundamental objectives, as discussed in the previous section, stages of hearing aid fitting have been described in the literature. The stages are: Prescription, selection, verification and validation (Boothroyd, 2000: 6; The Pediatric Working Group, 1996: 54). These stages will be discussed in the next section.

- *Stage one*: Prescription of amplification

Traditionally, when selecting hearing aids for infants, audiologists used a comparative hearing aid evaluation by measuring and comparing soundfield-aided thresholds with preselected hearing aids (Seewald et al., 1996: 164). A hearing aid was then selected from among the preselected instruments on the basis of the hearing aid evaluation test "findings". According to Seewald and colleagues (1996: 174) there are several limitations to using aided soundfield measurements for the purposes of selection-related decision-making to select a hearing aid for the infant with hearing loss. The first limitation of this procedure is that a reliable behavioural response and prolonged cooperation from the child are required. Secondly, even when a reliable aided threshold can be measured, the real-ear frequency response of the hearing aid under evaluation is being sampled at a very limited number of test frequencies. Thirdly, when soundfield-aided measures are used exclusively in choosing among the preselected instruments, several important electroacoustic characteristics of the options under consideration are ignored, including, for example, the input/ output characteristics and the output-limiting characteristics of the hearing aid across frequencies (Seewald et al., 1996: 164).

In the light of the limitations of these measures, mentioned in the previous paragraph, recent consensus statements have recommended that hearing aid prescription should be done in an *objective* manner (The Pediatric Working Group, 1996: 54, AAA, 2003: 1;). Prescription, according to Boothroyd (2002: 5), involves the specification of desired characteristics of amplification based on information of the infant as well as knowledge about the acoustics of speech and noise. Theoretical insights have led to the development of objective hearing aid *prescription formulas* that prescribe specific amplification characteristics, typically based on the diagnostic status of the hearing aid wearer (Scollie, 2005: 91; Snik & Stollman, 2000: 55). These formulas were designed to provide a systematic approach when selecting the electroacoustic characteristics of the hearing aids

that should result in appropriate detection, loudness, and intelligibility of amplified speech (Scollie, 2005: 91). The target frequency/gain and frequency/output values of hearing aids are specified (Hedley-Williams et al., 1996: 109).

The vast majority of prescriptive hearing instrument fitting procedures have been designed primarily for adults (Hawkins, 1993, as cited in Hedley-Williams et al., 1996: 109; Stelmachowicz, 2000a: 410). The use of a prescriptive approach is especially important for infants and toddlers who are unable to provide reliable information regarding their aided listening (Stelmachowicz, 2000b: 124). Only the Desired Sensation Level (DSL) (Seewald, 1988) was designed to specifically account for the many differences between young children and adults (Seewald, 1988: 18-22; Stelmachowicz, 2000b: 109). The DSL algorithm was designed to ensure that speech would be both audible and comfortable across a wide range of frequencies. Using this procedure, all audiometric and electroacoustic data are transformed to an equivalent ear canal sound pressure level (SPL) to facilitate comparison between audiometric results and hearing aid data. The procedure also accounts for factors that are unique to children. For example, age–related transforms to correct for ear canal size and corrections for the range of transducers used when testing children (e.g. insert ear phones, loudspeakers) are provided. In young children with small ear canals the SSPL measured in the ear will be considerably higher than that of adults (Seewald, 1995: 3) as noted previously. The DSL (Seewald, 1992) introduces generalised age-related corrections to the desired SSPL values. The DSL [input/output (i/o)](Seewald, 1992) procedure has been extended to include non-linear signal processing. The goal of DSL [i/o] (Seewald, 1992) is to supply amplification to average level speech to the desired sensation levels at each frequency and to make a wide range of input levels audible and comfortable without distortion (Seewald, 1992: 36). The age-related transforms of the DSL[i/o] (Seewald, 1992) have been included in the computation of other prescriptive procedures (Stelmachowicz, 2000a: 410).

A survey of the practice procedures of paediatric audiologists conducted in 1996 by Hedley-Williams and colleagues revealed that only 10% of the paediatric audiologists used a prescriptive approach when selecting the electroacoustic characteristics of hearing aids (Hedley-Williams, Tharpe & Bess, 1996: 110). Less than 10% reported use of the DSL formula. A follow-up amplification survey conducted in 2000 (Tharpe, 2000: 175-190) showed that about 70% of paediatric audiologists used a prescriptive approach. Although there seemed to be an improvement in the use of systematic prescription methods, 30% of audiologists still used their own personal approach (relying on clinical intuition). The Pediatric Working Group (1996: 53) states in this regard that an objective, timely strategy should be used and the traditional comparative approach to hearing aid selection is discouraged. For the comparative approach different hearing aids are worn for a period and subjectively compared to each other by the wearer (Seewald et al. 1996: 162). The use of an objective, systematic, quantifiable approach to prescribing hearing aid characteristics has become even more critical and challenging since it was recommended by The Pediatrc Working Group (1996: 53) almost a decade ago. Advances in technology are rapid and makes it even less desirable for audiologists to rely on their clinical intuition or subjective reviews of hearing aid benefit.

As hearing instrument circuitry has increased in complexity as a result of advanced signal-processing and digital technology, a number of fitting algorithms have been developed by manufacturers, generally on the basis of information obtained from adult hearing instrument users (Hawkins & Cook, 2003: 26). There are several disadvantages of using these algorithms when fitting infants with hearing aids. Often these algorithms are proprietary and may not be clearly defined in terms of specific goals or implementation. Furthermore “fine-tuning” of these hearing aids often requires judgements of quality or intelligibility that are not possible with infants (Stelmachowicz, 2000a: 411). A study by Hawkins and Cook (2003: 26, 28, 32 and 34) demonstrates that relying upon manufacturers’ automatic fittings

leads to substantially inconsistent fittings as the unique characteristics of each infant's ears are not taken into account. Manufacturers' automatic fittings are also mainly based on adult data. To apply advances in signal processing to infants who are in the process of developing speech and language, it is important to understand the unique acoustic needs of this population (Stelmachowicz, 2000a: 411). The Pediatric Working Group (1996: 53) states that because of these advances in hearing aid technology and the new array of amplification options available for application to infants and children, the need for a systematic, quantifiable and evidence-based approach to providing amplification to the paediatric population is critical.

- *Stage two:* selection of amplification

Selection involves finding or adjusting an instrument to match the prescription as closely as possible (Boothroyd, 2000: 6). There are many decisions that should be made prior to selecting amplification for a child. These decisions may be based on the individual needs and abilities, diagnostic information, environment in which the infant functions, empirical evidence and clinician experience (Pediatric Amplification Protocol, 2003: 4). Many of these decisions should be revisited on an ongoing basis as the child matures. The characteristics of the hearing aids are often chosen because of their practicality (Stemachowicz, 2000: 416). An important principle when choosing specific hearing aid features is to use a flexible instrument that allows for changes as the infant grows (Buerkli-Halevy & Checkley, 2000: 77). The specific hearing aid features or characteristics that are recommended for the use with infants with hearing loss will be depicted in table 2.1 (references are supplied in the table).

Table 2.1 Pre-selection issues/characteristics of the amplification and evidence suggesting its use

Feature/ characteristic	Recommended for use when fitting infants	Reason/ evidence
1. Hearing aid style: behind-the-ear (BTE), in-the-ear (ITE), in-the-canal (ITC), completely-in-the-canal (CIC)	BTE	• Outer ear might grow well into puberty, thus dictating the BTE style. • More durable (no circuitry directly exposed to cerumen). • Less likely to produce feedback with properly fitted mould. • Allows for a variety of essential features (telecoil circuitry, direct audio input connection, built in FM circuitry). (Pediatric Amplification Protocol, 2003: 5)
2. Hearing aid retention aids	1. Retention straps 2. "Huggie aids" 3. Double side tape	• While not a problem at two or three months of age, many families report that they have problems with the infant removing the hearing aids beginning at about four or five months of age (Roush, 2005: 110). • To be used as a short-term strategy.
3. Receiver type	Class B or D	• Far superior to the class A receiver in terms of sound quality (Palmer, et al., 1995: 11).
4. Ear mould	Silicon/ Vinyl	• Should be soft but not too soft, should be firm enough so that the sound bore of the ear mould remains patent when inserted in the ear canal, soft for comfort, vinyl's tubing can be glued into place (vs. that of silicon) (Beauchaine 2002: 106). • Ear mould replacing can be as frequent as monthly at first (Pediatric Amplification Protocol, 2003: 7).
5. Ear hook and tube	1. Paediatric size ear hook 2. Filtered/ damped ear hook	• Ear hook adds resonant peaks to the hearing aid response. Acoustic feedback can increase as a result and dictate the MPO of the hearing aid and reduced headroom[7] of the hearing aid. A filtered ear hook will smooth the response (Scollie & Seewald, 2000b: 695).

[7] Headroom: the difference between the level of speech and the saturation level of the hearing aid (Pediatric amplification protocol, 2003: 7).

Table 2.1 Continued

Feature / characteristic	Recommended for use when fitting infants	Reason / evidence
6. Microphone	1. Omni-directional 2. Switchable microphone (between omni- and directional)	• *Directional microphones* can enhance hearing in noise in adults and may be beneficial to younger listeners in some situations (such as in a baby chair in a restaurant) (Beauchaine, 2002: 105). • The signal of choice is in front of the listener, young infants are often not face to face with parents, and when crawling they often face away from them *dictating an omni-directional microphone.* • Omni-directional microphones are also important for safety reasons (Stemachowicz, 2000: 417). • Some hearing aids' ability to switch between omni and directional microphones may not be needed initially but may be useful as the child gets older (Roush, 2003: 108).
7. Controls	1. Volume control (VC) 2. Other controls: Telecoil (T), microphone-telecoil (M-T) switching options	• The need for a volume control is dictated by the signal processing scheme that is used; linear signal processing implies the use of a VC. • VC should be covered (Pediatric Amplification Protocol, 2003: 10). • (The Pediatric Working Group, 1996: 56).
8. Ability to couple to assistive listening technology	FM system (Frequency modulated[8] technology)	• Widely used and commonly studied in classroom studies where reverberation, echoes and poor signal-to-noise ratio are problems and FM systems are applied to overcome these problems (Gabbard, 2005: 156). • Much of the infants' awake time is spent in close proximity to the caregivers; when they start crawling and the distance between the infant and the speaker increases FM technology can be considered (Gabbard, 2005:157). • The use of FM systems with young children may be beneficial to improve audibility for children with severe-to-profound hearing loss (Moeller et al.: 1996: 40). Input intensity to the hearing aids from the remote microphone is increased, with increase in audibility as a result. • Ear level receivers that can couple to the hearing aids are preferable to body worn devices as it facilitates a consistent signal to the infant's ear drum, the hearing aid and/or FM microphone and are easier for the parents to accept and manage (Gabbard, 2005: 158).

[8] FM system: The signal from a remote microphone can be sent directly into the ear of a listener by using FM system technology and a variety of transmitters and receivers (Gabbard, 2005: 156).

Table 2.1 Continued

Feature / characteristic	Recommended for use when fitting infants	Reason / evidence
9. Battery doors	Tamper-resistant battery doors	• Tamper-resistant battery doors should be used for safety. (Pediatric Amplification Protocol, 2003: 9). • Many families report that they have problems with the infant removing the hearing aids beginning at about four or five months of age (Roush, 2005: 110). Without a tamper-resistant battery door swallowing of the battery poses a real danger to the infant.
10. Signal processing strategies/ schemes	Suggestions from the Pediatric Amplification Protocol (AAA, 2003: 10-12) unless otherwise stated.	• Some principles should apply to the signal processing strategies of the hearing aids, regardless of the technology (digital or analogue). It is likely that all hearing aids will be digital within the next five years and the analogue versus digital decision will be irrelevant. • Basic requirements of signal processing strategy/ scheme: o low distortion; o system should allow frequency-output shaping to provide audibility based on an appropriate prescriptive method; o system should allow frequency-output shaping to aid safety and comfort based on an appropriate prescriptive method; o wide dynamic range compression (WDRC) may routinely be necessary to allow for audibility of soft to loud inputs (Jenstad, 2000: 43). WDRC may be an appropriate way to compensate for children's reduced performance at low sensation levels, without posing a risk for residual hearing (Stelmachowicz, 2000b: 116); o compression output limiting has been shown to provide superior sound quality as compared with peak clipping output limiting (Hawkins & Naidoo, 1993 in Pediatric Amplification Protocol, 2003: 10); o the system should include sufficient electroacoustic flexibility to allow for changes in required frequency/output characteristics related to growth of the child (e.g. size of the ear canal); o many schemes under development to reduce background noise (digital noise reduction) and /or enhance speech perception (e.g. spectral enhancement) cannot be recommended until data relative to their effectiveness become available; o some digital applications might be beneficial to infants with hearing loss such as: Automatic feedback control (caution is advised where gain reduction is used as audibility might be reduced), multiple channels for fine tuning the frequency response, WDRC and increasing the specificity of noise reduction and feedback control and expansion to reduce low-level noise.
11. Hearing aid kit		• Parents and teachers should be provided with a hearing aid kit that should include at least a stetoclip and air puffer for daily maintenance (NDCS, 2000:15). • Parents usually welcome the use of a stetoclip that can be used for regular listening checks of the equipment (Gabbard, 2005: 157).

From the table it is apparent that the selection of hearing instruments for infants requires consideration of their unique needs. Electroacoustic flexibility is a key consideration when selecting hearing aids for infants, since it is often necessary to proceed with limited information regarding the degree and configuration of the hearing loss (Roush, 2005: 108). With the use of programmable and digital hearing aids there are now many hearing aids that have multiple channels and the flexibility to fit a wide range of hearing loss (Roush, 2005: 108).

- *Stage three:* Verification of the fitting:

Verification involves measuring the acoustic performance of the subject to determine whether the goals of prescription have been met (Boothroyd, 2002: 6). "In the context of early intervention, infants will wear their hearing aids at fixed, clinician-determined settings for months or years before they are able to clearly express their preferences" (Scollie, 2005: 91). This quotation stresses the importance of *objectively* verifying the clinician-determined hearing aid settings for the infant with hearing loss. As described in the previous section on prescription of hearing aids, aided soundfield thresholds were traditionally used to preselect and evaluate hearing aided performance (Seewald et al., 1996: 170-172). Even with advances in technology as well as increased evidence-base very few audiologists included probe-microphone measurements (discussed in the following section) as part of the verification strategy, according to the Hedley-Williams and colleagues survey (1996: 107-122). Aided soundfield thresholds and speech measures in quiet appeared to be the approaches of choice (Hedley-Williams, Tharpe & Bess, 1996: 111). Although the majority of audiologists in the Tharpe (2000) survey used objective measures (either traditional probe microphone or

real-ear-to-coupler difference[9] (RECD)) to verify output-limiting ability of the hearing aid, 30% still used behavioural measures to verify output limiting (Tharpe, 2000: 184). In this regard the Pediatric Amplification Protocol (AAA, 2003: 12, 13) discourages the use of aided soundfield measures as a way of verifying electroacoustic characteristics of hearing aids in infants for the following reasons:

- prolonged cooperation from the child is required;
- frequency resolution is poor;
- test-retest reliability is frequently poor;
- misleading information may be obtained in some cases e.g. where non-linear signal processing is used;
- characterisation of how the hearing aid or FM will perform under everyday listening situations are limited, simplistic and under some electroacoustic conditions invalid (Seewald et al., 1996: 173).

(The use of aided soundfield measures as a validation tool will be discussed in the following section on validation.)

Prescriptions (as discussed in the section on pre-selection of the hearing aids) have been defined electroacoustically, they are subsequently meant to be verified using specific electroacoustic measures to ensure that the prescription is achieved by the hearing aid within reasonable tolerance (Scollie, 2005: 91). As discussed previously sound pressure levels in the infants' and children's ears typically exceed adult values (Stelmachowicz, 2000a: 411). Another factor influenced by the smaller size of the infant's ear is the difference in external ear canal resonance (The Pediatric Working Group, 1996: 55). As a result of these differences the difference that is associated with real ear measurements for gain and output and these coupler values in adults is even greater for children and can be as large as

[9] The prediction/ (derivation) of the real-ear sound pressure level (SPL) by adding individually measured acoustic transfer function to both the audiometric and electroacoustic data. The acoustic transfer function in question is known as the "real-ear-to-coupler-difference" (Munro, 2005: 71).

15 to 20dB (Feigin, Kopun, Stelmachowicz & Gorga, 1989, as cited in Munro, 2005: 71). In general it is believed that the RECD does not approximate adult values until seven years of age (Stelmachowicz, 2000a: 417). It is crucial to account for this expected increase in real-ear SPL when fitting hearing aids to infants and young children (Stelmachowicz, 2000a: 417). The best way to accomplish this is to obtain real-ear measures of gain and output using a probe-microphone system (The Pediatric Working Group, 1996: 55). Performing traditional probe-microphone techniques to younger children is often hindered by movement, vocalisations and lack of head-control (Moodie, Seewald & Sinclair, 1994: 23). To overcome these problems Seewald and colleagues (1994: 23-29) have described an innovative technique for estimating real-ear performance by using coupler values and an individually measured RECD. The RECD procedure requires minimal cooperation from the child and can be performed in less than five minutes. All subsequent measures can be performed in a test box and the RECD can be applied to predict real-ear gain and output. It is recommended that a new RECD should be obtained each time the earmould is replaced (Moodie, Seewald & Sinclair, 1994: 23-31). This technique has been shown to be both valid and reliable (Scollie et al., 1998: 407-413). The Pediatric Amplification Protocol (AAA, 2003: 13) recommended that if probe-microphone measures of real-ear hearing aid performance are possible, hearing aid performance can be predicted accurately in the real ear by applying age appropriate average RECD values to the measured coupler electroacoustic results (Seewald et al., 1999, as cited in AAA, 2003: 13).

A study done by Bagatto, Scollie, Seewald, Moodie and Hoover (2002: 407-415) investigated real-ear-to-coupler difference (RECD) predictions as a function of age for two coupling procedures in order to update available normative RECD values. Significant between-subject-variability confounded their objective. As a result these investigators favoured individual measurement of RECD over predictive estimates. Finally, with regard to the signals used during probe microphone measurements, it is recommended by the Pediatric Amplification Protocol (AAA,

2003: 13) that the audiologist should select signals that ensure accurate electroacoustic verification. Scollie and Seewald (2002a: 477-487) examined the difference between the results of electroacoustic testing with aided test signals and aided speech. Three test signals were compared to running speech. Results showed that speech weighted or temporally modulated test signals more accurately matched aided levels of speech for all types of hearing aids. As hearing technology changed (processing various input signals in different ways) the audiologist should update his or her knowledge and also his or her equipment with newly developed signals (Scollie & Seewald, 2001, as cited in AAA, 2003: 13).

Finally, as audibility is one of the main goals of the paediatric fitting, the Situational Hearing Aid Response Profile (SHARP) (Stelmachowicz, Lewis, Kalberer, Creutz, 1994, as cited in Stelmachowicz 2000a: 411) developed a computer-based programme to verify predicted audibility in a variety of settings that can not easily be measured in a clinical setting (Stelmachowizc, 2000a: 411). Measured hearing aid characteristics (test chamber or probe-microphone data) are entered into this programme and the audibility for 12 different listening situations (e.g. cradle position, hip position etc.) is evaluated. This can be useful when counselling parents or providing documentation to educators regarding the implications of hearing loss.

- *Stage four*: Validation

Validation is the process of determining whether the prescription was appropriate in the first place, that is whether auditory capacity has been brought to the highest possible level (Boothroyd, 2002: 6). Another definition of validation is supplied by the Pediatric Amplification Protocol (AAA, 2003: 15) and reads: “Validation of auditory function is a demonstration of the benefits and limitations of aided abilities and begins immediately after the fitting and verification of amplification.” Validation is seen as an ongoing process designed to ensure that the child is

receiving optimal speech input from others and that his or her own speech is adequately perceived (The Pediatric Working Group, 1996: 56). In this regard the aided soundfield response plays an important role. Two advantages of these measurements are that the results of this test provide information about the child's auditory performance in terms of the ability to detect the presence of sound within the aided condition and the results are presented on a conventional audiogram, a context that is familiar to relevant professionals and parents (Seewald, et al., 1996: 166). Aided speech perception measures may also be included in the validation process (Pediatric Amplification Protocol, 2003: 15). Finally questionnaires completed by parents or caregivers may also provide useful validation mechanisms.

This section served to examine evidence and new developments important for the audiologists when fitting hearing aids to infants with hearing loss. The fundamental objectives when fitting hearing aids to infants were discussed and explained. The process of fitting hearing aids to infants was discussed in four stages: Prescription, selection, verification and validation. Important principles and developments were discussed in each phase.

2.3.3.1.2 Aural rehabilitation

The acquisition of language and communication competence is a primary focus of EHI programmes (JCIH, 2000: 18). In line with this focus Stach (1997: 176) defines aural rehabilitation as "treatment of persons with hearing impairment to *improve overall communication ability*, including the use of hearing aids, auditory training, speech reading, counselling and guidance". From this definition it is clear that the use of hearing aids is but one component of the rehabilitation process. This is however not the way rehabilitation has been viewed in the last few years (Ross, 2004: 1). Aural rehabilitation (A/R), even the traditional types of

speechreading and auditory training, rarely takes place according to him (Ross, 2004:1). Kochkin (2000, as cited in Ross, 2004:1) found that 87% of new hearing aid users received one hour or less of follow-up counselling, while 43% received a half-hour or less. Ross (2004:1) comments: "No matter how efficient we are in providing services, this simply is not enough time to effectively communicate A/R issues and strategies. With such little time allotted, the focus has remained on the hearing aid itself. This type of practice trivialises the sense of hearing and the role audition plays in our lives". These comments were made referring to adult A/R services. Yet, a review of the literature with regard to infants with hearing loss conveys a similar message.

Johnson and Danhauer (2002: 204) in the Handbook of Outcomes Measurement in Audiology note that many audiologists do not provide "direct-service therapy" for infants with hearing loss. In search for possible explanations the existing consensus/ position statements and protocols were scrutinised. These position statements and protocols (Year 2000 Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs (JCIH), 2000: 9-29; The Pediatric Working Group of the Conference on Amplification for Children with Auditory deficits, 1996: 53-68; and the Quality Standards in Paediatric Audiology - Guidelines for the Early Identification and the Audiological Management of Children with Hearing Loss, 2000:1-24) emphasise the fitting of amplification and confirm the principle of auditory rehabilitation for infants with hearing loss, but detail information or guidelines to assist in the rendering of these services are rarely supplied.

The guidelines and recommendations supplied by The Pediatric Working Group (1996) focus on the fitting process and the topics of counselling and follow-up are discussed but not treated in detail (The Pediatric Working Group, 1996: 53). Similarly the Year 2000 Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs (JCIH, 2000: 9-29) promotes

communication assessment and intervention but supplies no detail. (JCIH, 2000: 19). In describing the audiologist's responsibilities in the EHI programme the statement states that (in addition to the fitting of amplification, family education, counselling and ongoing participation in the infant's services plan), the audiologist should provide direct aural rehabilitation services to infants and families, and should participate in the assessment for cochlear implantation (JCIH, 2000: 46). The Position Statement (JCIH, 2000: 19) states that oral and/or sign language abilities should be appropriate for the infant's age and cognitive abilities and should include acquisition of phonological (for spoken language), visual/spatial/motor (for signed language), morphologic, semantic, syntactic, and pragmatic skills. This can be achieved by "providing information specific to language development and with family-involved activities that facilitate language development. Information on visual communication methods (sign language) and cued speech should be provided. Information on oral/auditory language, personal hearing aids, and assistive devices such as FM systems, tactile aids, and cochlear implants should also be made available". The statement (JCIH, 2000: 9-19) does not supply guidelines for the duration of treatment, progress milestones, determination of possible benefit from treatment and establishment of guidelines for the average number of visits needed to achieve age appropriate language and communication milestones (Task Force on Treatment Outcomes and Cost Effectiveness, 1997, as cited in Johnson & Danhauer, 2002: 204).

In omitting these details, the message is conveyed that A/R might not be as important, or might not be the responsibility of the audiologist. In the position statement the role of the speech-language pathologist is described as the provision of evaluation and treatment for language, speech, and cognitive-communication development (ASHA, 1989 in JCIH, 2000:13). In the Quality Standards in Paediatric Audiology - Guidelines for the Early Identification and the Audiological Management of Children with Hearing Loss (2000:1-24) it is stated as the responsibility of audiologists to *direct* families towards the availability of sign

language classes and to supply families with information, advice and guidance on deaf awareness and good communication (NDCS, 2002: 17). It is thus possible that audiologists do not supply these services but refer to team members of the multidisciplinary team as suggested by these guidelines.

This is however not in accordance with the scope of audiology practice as set out in the Scope of Practice in Audiology statement (ASLHA, 2004: 1-9). The document states the following as one of the professional roles and responsibilities of audiologists: "*Provision* of comprehensive audiologic rehabilitation services, including management procedures for speech and language habilitation and/ or rehabilitation for persons with hearing loss or other auditory dysfunctions, including but not exclusive to speech reading, auditory training, communication strategies, manual communication and counselling for psychosocial adjustments for persons with hearing loss and other auditory dysfunction and their families/ caregivers" (ASLHA, 2004: 5). It is clear from this statement that the audiologist should provide these services to the infant with hearing loss. Ross (2004: 1) believes that: "as much as possible, we should return to the original model, in which the dispensing of hearing aids was but a single component of a rehabilitative process, rather than an end in itself. We need to do more than focus on the hearing aid as a miracle device. We don't want to send the message that the hearing aid is a sufficient response to problems wrought by hearing loss. In fact, it is necessary to deal with all the other issues that accompany hearing loss... In brief, what I'm recommending is hearing aid dispensing should be redefined, such that the hearing aid itself, would serve as a component of a rehabilitative process".

Another controversy in the field of aural rehabilitation is that treatment approaches have not been required to demonstrate treatment efficacy through the use of randomised clinical trails prior to use with children (Johnson & Danhauer, 2002: 204). Treatment outcome data for aural rehabilitation are needed for the

prediction of treatment duration, progress milestones, determination of likely benefit from treatment and establishment of guidelines for the average number of visits to achieve goals (Task Force on Treatment Outcomes and Cost Effectiveness, 1997, as cited in Johnson & Danhauer, 2002: 204). Efficacy studies comparing various A/R approaches used in EHI programmes are difficult to conduct because of the influences of possible confusing variables; these variables are difficult to control, have fundamental selection biases and do not supply a detailed description of the interventions (Bamford, 1998, as cited in Johnson & Danhauer, 2002: 209).

In this section issues concerning A/R were discussed. Bamford (1998, as cited in Johnson & Danhauer, 2002: 210) predicted that long-term outcomes for language acquisition and communication competence in EHI programmes (the aim of A/R) would include development of language and communicative competence, development of age appropriate behaviours, social and emotional development, long-term mental health, educational placement and achievement and economic opportunities such as employment.

2.3.3.2 Multidisciplinary teamwork

The success of the EHI programme depends on the professionals working in partnership with families in a *well-coordinated multidisciplinary team* (Moeller, 2000 in JCIH, 2000: 12). Following the confirmation of hearing loss, most parents of infants with hearing loss will have contact with many different professionals from a range of services. Consistent and coherent support will be ensured by well co-ordinated and "seamless" services (NDCS, 2002: 16). Multidisciplinary team working has several benefits for professionals such as:

- the avoidance of duplication;

- shared information and improved communication;
- professionals learn from each other and about each other's roles;
- the team can provide a supportive knowledgeable framework for making difficult or complex decisions and providing timely intervention;
- parents' knowledge and expertise are valued; and
- it creates opportunities to monitor and evaluate services and support in a co-ordinated and consistent way.

Participating as a member of the team, the audiologist can provide input regarding ongoing family education and the development of an audiological management plan (Diefendorf et al., 1996: 136). In addition the audiologists can contribute to the team by providing access to resources regarding the hearing loss and management, by facilitating open and frequent communication and by encouraging flexibility and innovation (Diefendorf, 1996: 136). The following table identifies the essential members of the team working with the infant with hearing loss, and their roles as it was specified in the Year 2000 Position Statement of the JCIH (pp. 12 &13).

Table 2.2 Multidisciplinary team members working with the infant with hearing loss

Team members:	Responsibilities:
Families	• All the family's preferences should be incorporated into an individualised family service plan. • Provision should be made for supportive family education, counselling and guidance should be available. • Advocates for the infant with hearing loss.
Paediatricians/ primary care physicians	• Part of the infant's "medical home": An approach to providing health care services where care is accessible, family-centred, continuous, comprehensive, coordinated, compassionate, and culturally competent. • Provide a global plan of appropriate and necessary health and habilitative care .
Audiologists	• Involved in each component of the EHI programme. • Involved in continuous audiological assessments. • Assist family in effective transition from screening to evaluation, habilitative and intervention services. • Provide timely fitting and monitoring of amplification (sensory devices and assistive technology). • Assessment of programme quality. • Assist family in advocating for its infant's unique developmental needs. • Provide family education. • Provide counselling to the family. • Ongoing participation in the infant's service plan. • Provide direct auditory habilitation services. • Participate in the assessment for cochlear implantation. • As service coordinator (case manager): Monitors the timeliness of services and sources, communication choices and emotional support.

TABLE 2.2 Continued

Team members:	Responsibilities:
Otolarygologist/ (Ear, Nose and Throat Specialist)	• Definition: Physicians whose speciality includes the identification, evaluation and treatment of ear diseases and syndromes related to hearing loss. • Determines the etiology of hearing loss. • Determines the presence of related syndromes involving the head and neck structures and related risk factors for hearing loss. • Determines whether medical and/or surgical intervention may be provided. • Long-term monitoring and follow-up after medical and/or surgical intervention. • Provides information and participates in the assessment for candidacy of amplification, assistive devices and cochlear implantation.
Speech-language pathologist	• Provides evaluation and treatment for language, speech and cognitive communication development.
Educators of children with hearing loss	• Integrates the development of communicative competence within the infant's entire development, including a variety of social, linguistic, and cognitive/ academic context.
Other early intervention specialists involved in delivering EHI services	• Should have training and expertise in auditory, speech and language development, communication approaches for infants and their families (e.g. sign language systems) and child development.

Compiled from: The Year 2000 Position Statement of the JCIH (pp. 12 &13).

Table 2.2 specifies the following members as essential when working with infants with hearing loss: Families, paediatricians/ primary care physicians, audiologists, otolarygologist/ (ear, nose and throat specialist), speech-language pathologist, educators of children with hearing loss and other early intervention specialists involved in delivering EHI services. Their roles and responsibilities were specified in table 2.2.

The following quotation from a parent in the NDSC Quality Standards in the Early Years: Guidelines on working with deaf children under two years old and their families (NDCS, 2002: 16) booklet serves to inform professionals of the importance of the "seamlessness" of the multiprofessional team: "I don't know why, but each time we went to see a professional I had to start from scratch and tell my story and explain what the other professionals had told me. Surely there must be a way of sharing information so time isn't wasted going over the same thing time and time again."

The NDCS Quality Standards in the Early Years: Guidelines on working with deaf children under two years old and their families (NDCS, 2002: 16) provide valuable guidelines for sharing the information. These guidelines will be summarised in the following section:

- Joint planning by professionals and parents is a crucial aspect of multidisciplinary teamwork.
- Information should be available about the services rendered by the different members and should be shared between members of the team to avoid duplication and to aid communication. It is necessary to receive the consent of parents in relation to the sharing of reports and information between professionals (NDCS, 2002: 16).
- Assessments should be well co-ordinated between team members and parents.
- One "key aim" of multidisciplinary working should be to reduce disruption to family life (NDCS, 2002: 17). This could be achieved by joint appointments.

Rendering EHI services in an effective way by integrating and coordinating multidisciplinary personnel and resources in a “seamless”, effective manner will insure that intended outcomes of the IFSP are achieved. The previous section summarised the components of the EHI programme that might ultimately influence the quality of EHI services to infants with hearing loss.

The discussion so far focused on the importance of EHI, factors influencing EHI services, internationally and in South Africa (these factors included the audiologists, the involvement of the family, as well the components of the EHI programme). Relevant literature was reviewed, controversies were discussed and evidence was gathered. This knowledge base will serve to define the international best practice benchmarks against which the EHI services can be evaluated.

2.4 DEFINING THE BENCHMARKS DERIVED FROM THE INTERNATIONAL EVIDENCE BASE FOR EHI AND SUPPORT SERVICES

Through the literature review benchmarks are defined against which EHI can be evaluated. The following table provides these benchmarks that delineate good quality EHI services, gathered from the international evidence base and serves to conclude and summarise guidelines for best practice.

Table 2.3 Benchmarks derived from the international evidence base, categorised in the six M variation categories

EARLY HEARING INTERVENTION SERVICE	BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES
1. MAN	**This category should include everyone involved in EHI services**
1.1 The audiologist/ EHI specialist	• The audiologist should have experience of the assessment and management of infants and children with hearing loss and the commensurate knowledge of current pediatric hearing aid selection and evaluation procedures (The Pediatric Working Group, 1996: 53; JCIH, 2000: 10). • EHI specialists should be trained in: o working in partnership with parents; o working in partnership with other professionals; o hearing loss; o early child development; o the development of language and communication; o audiological support; o emotional support and counselling skills; o providing accurate and unbiased information; o monitoring progress; o managing/ coordinating service delivery to families, multi-professional teamwork; o cultural and religious diversity (JCIH, 2000: 18).
1.2 The infant or child with hearing loss	• Infants with hearing loss are enrolled in a family-centered early intervention programme before six months of age (JCIH, 2000: 11). • An infant needs hearing aids when there is a significant, permanent, bilateral peripheral hearing loss (25dB or more in the 500 Hz through 4000 Hz region) (The Pediatric Working Group, 1996: 54).

Table 2.3 Continued

EARLY HEARING INTERVENTION SERVICE	BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES
1.2 The infant or child with hearing loss (continued)	• Children with permanent bilateral hearing loss should be provided with two hearing aids, unless there are justifiable contraindications (NDCS, 2000: 14). • The early years' support services should be available immediately after hearing loss has been confirmed (NDCS, 2000: 14; NDCS, 2002: 11). • Infants with hearing loss and no medical contraindication begin use of amplification when appropriate and agreed on by the family within one month of confirmation of hearing loss (JCIH, 2000: 18; NDCS, 2000: 14).
1.3 Family or caregivers	• Parents should be fully involved in deciding on the support and intervention of their child with hearing loss, as well as monitoring and evaluating the effectiveness of the support programme (NDCS, 2002: 13). • Regarding the planning and delivering of the support to the family the following should be considered: Early intervention services should be shaped to meet the individualised needs of the infant and family, including addressing acquisition of communicative competence (in the family's chosen communication mode), diverse demographics, social skills, emotional well-being, and positive self-esteem (Karchmer & Allen, 1999 as cited in NDCS, 2002: 13). It should not remain static, but should be reviewed every six months. • Parents should be given information about relevant support groups or charities (NDCS,2000: 12).

Table 2.3 Continued

EARLY HEARING INTERVENTION SERVICE	BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES
1.3 Family or caregivers (continued)	• Parents should be given copies of audiograms and other audiological assessments, with a full explanation (NDCS, 2000: 12). • Documented discussion should occur about the full range of resources in early intervention and education programmes for children with hearing loss (JCIH, 2000: 17). • Families participate in and express satisfaction with self-advocacy (JCIH, 2000: 17).
1.4 Team members	• A true multidisciplinary team should include parents and named individuals from all services, supporting the infant with hearing loss. Essential team members are families, paediatricians, audiologists, ear, nose and throat specialists, speech-language pathologists, educators of children with hearing loss, and other professionals involved in delivering EHI (JCIH, 2000: 12).
2. METHOD	**This refers to the systematic procedures or protocols used during all the components of the EHI services (JCIH, 2000, p.13).**
2.1 Regarding the EHI programme	• All components of the EHI programme should be provided using a systematic, quantifiable and evidence-based approach (The Pediatric Working Group, 1996: 53). • Quality should be assured through available benchmarks and standards for each stage of the EHI process (JCIH, 2000: 24).

Table 2.3 Continued

EARLY HEARING INTERVENTION SERVICE	BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES
2.1 Regarding the EHI programme (continued)	• The following components should form part of the EHI programme (JCIH, 2000: 17): o developing an individualised family service plan (incorporating the family's preferences for outcomes); o selection of amplification; fitting of amplification; o selection of assistive technology; fitting of assistive technology; o verification of the fitting; o ongoing monitoring of the findings: ✓ Hearing aid fitting and assessment should be reviewed weekly for newly diagnosed babies, and every two months once hearing aid provision has been established for the first two years of using amplification and every four to six months after that time (NDCS, 2000: 14, The Pediatric Working Group, 1996: 56). o family education and counselling; o participate in the assessment for candidacy for cochlear implantation; o provision of direct auditory rehabilitation services (e.g. auditory and speech training): ✓ The audiologist should, together with the speech-language pathologist and other team members, provide language and communication assessments as well as training (for receptive as well as expressive language development). This should include auditory, visual, auditory-visual training (e.g. speech reading, auditory training, listening skills) depending on the family's preferred communication mode. (ASLHA, 2002:92, NDCS, 2002:16). o working in a multidisciplinary team; o (The Pediatric Working Group, 1996: 54, Pediatric Amplification Protocol, 2003: 1-10.

Table 2.3 Continued

EARLY HEARING INTERVENTION SERVICE	BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES
2.2 Follow-up visits	• Follow-up visits should include: o behavioural audiometric evaluations; o current assessment of communication abilities, needs, and demands; o adjustment of the amplification system based on updated audiometric information and communication demands; o periodic electroacoustic evaluations listening checks; o earmould fit checks; o periodic probe-microphone measurements; o periodic functional measures to document development of auditory skills; o long-term follow-up including academic progress (with the multiprofessional team; (Pediatric Amplification Protocol, 2003: 1-10).
3. MEASUREMENT	**This would include all measurements during the early intervention services rendered to children with hearing loss (audiometric measurements included)**
3.1 Selection and verification of electroacoustic characteristics of amplification	• Probe microphone measurements of real-ear hearing aid performance should be obtained with children whenever possible (The Pediatric Working Group, 1996: 18). • Target values for frequency/gain and frequency/output limiting characteristics should be selected according to standard prescriptive procedures designed for children (e.g. Desired Sensation Level, Seewald, 1992; NDCS, 2000: 15). • The hearing aid should be pre-set in a hearing aid test box using published or preferably measured Real Ear to Coupler Difference (RECD) values (The Pediatric Working Group, 1996: 55). • Measurements to verify output limiting include the direct measurement of the real ear saturation response (RESR).

Table 2.3 Continued

EARLY HEARING INTERVENTION SERVICE	BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES
3.2 Validation of aided auditory function	• Aided auditory function should be measured using aided sound-field responses (The Pediatric Working Group, 1996: 55). • Questionnaires.
4. EQUIPMENT (MACHINE)	**This category includes all the audiological equipment necessary to do the measurements during EHI services**
4.1 Selection, verification and the validation of the hearing aid/ assistive listening devices fitting	• Equipment to do probe-microphone measures and electroacoustic evaluations, hearing aid black box (AAA, 2003: 13). • Audiometre for the validation of auditory function with amplification: Calibrated at least annually using the manufacturers' specifications or ANSI S3.39-1987) (HPCSA, 2002b: 2).
5. AMPLIFICATION DEVICES (MATERIAL)	**Apparatus necessary in the EHI process.**
5.1 Hearing aids	• Hearing aids for most children should include Direct Audio Input (DAI), telecoil (T), and microphone-telecoil (M-T) switching options. • In general, behind the ear (BTE) hearing aids with safety-related features (such as tamper-resistant volume and battery controls) are the style of choice for children under eight years (The Pediatric Working Group, 1996: 54). • Earmoulds for use with BTE hearing aids should be constructed of soft material (The Pediatric Working Group, 1996:54). • Electroacoustic performance of the hearing aids should be checked every six weeks in accordance with IEC standards. • A flexible, wide dynamic range compression hearing aid with low distortion is preferable. The unique combination of decisions will lead to the selection of particular hearing aids for a particular child. (Pediatric Fitting Protocol, AAA, 2003: 13).

TABLE 2.3 Continued

EARLY HEARING INTERVENTION SERVICE	BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES
5.1 Hearing aids (continued)	• Parents and teachers should be provided with a hearing aid kit that should include at least a stetoclip and air puffer for daily maintenance (NDCS, 2000: 15).
5.2 Assistive listening devices	FM systems can be considered (JCIH 2000:19).
5.3 Cochlear implants	Parents should be informed and referred to specialised team members (NDCS, 2000: 17).
6 MOTHER NATURE	**This category includes: The natural environment (geographic and topographic factors, climate, atmosphere and weather patterns), the manmade physical environment and the socio-cultural environment.**
• The natural environment (geographic and topographic factors, climate, atmosphere and weather patterns) • The manmade physical environment • Socio-cultural environment o Financial constraints o Accessibility of health services (fewer professional resources, deaf role models, sign language interpreters) o Educational levels of family or caregivers	• These factors underscore the necessity of providing comprehensive, culturally sensitive information to families in the individualised EHI plan (JCIH, 2000: 18). • Parents should receive all information in their preferred language. Interpreters should be provided if necessary (NDCS, 2002: 16).

Compiled from: National Deaf Children's Society (NDCS) Quality Standards in the Early Years, (2002: 1-30), NDCS Quality Standards in Paediatric Audiology (2000: 1-24), the Position Statement of the Joint Committee on Infant Hearing (2000: 9-29), The Pediatric Working Group (1996: 53-68) and the American Academy of Audiology (AAA) Pediatric Amplification Protocol (2003: 1-19).

Table 2.3 summarises the *benchmarks* provided by *preferred/ or best practice*

guidelines gathered from the considerable international evidence base (Bamford, 2001: 329). Benchmarks are quantifiable goals or targets by which an EHI programme may be monitored and evaluated. Benchmarks are used to evaluate progress and to point to needed next steps in achieving and maintaining a quality programme (JCIH, 2000: 12). By using best practice guidelines for paediatric hearing intervention and categorising them into one of the above six M variation categories, variation in EHI services can be described and managed. The benchmarks as summarised in table 2.3 were categorised as such. As motivated in chapter one it is essential that the ultimate aim should be to have audiological intervention services to infants and young children in South Africa aligned with international best practice guidelines and quality standards. To realise this aim, knowledge of current performance is essential. The HSPS of the Professional Board for Speech, Language and Hearing Professions (HPCSA, 2002: 3) states that quantifiable goals and quality indicators should be determined for the monitoring and evaluation of EHDI programmes and that periodic review should take place to assure quality of EHDI programmes.

2.5 SUMMARY

Through review of the literature and knowledge base a historical overview of EHI and its importance were supplied. The existing evidence base and literature that define international best practice guidelines in service provision to infants with hearing loss were discussed. Factors influencing this service provision with specific emphasis on the unique challenges faced by the South African audiologist were emphasised. This chapter related controversies, benefits and limitations in this field and concluded with a summary of the benchmarks provided by international best practice guidelines gathered from the international evidence base.

Audiologists need to access the international evidence base and use it to acquire the knowledge needed to provide high quality EHI services. As the knowledge circle will widen, the questions will become more. In order to answer these questions for the South African infant with hearing loss, EHI services need to be contextually relevant and evidence-based.

CHAPTER 3

METHODOLOGY

Aim: To present the methodological approach used to supply the operational framework for gathering the research data.

The main aim and sub-aims, research design, subject selection, material (for subject selection as well as the gathering of research data), procedures (for subject selection as well as the collection and recording of data), the questionnaire design, pilot study, validity and reliability and ethical issues will be discussed.

"We have to remember that what we observe is not nature in itself but nature exposed to our method of questioning"

Werner Heisenberg (1901-1976)

3.1 INTRODUCTION

In South Africa in a time of health care reform, when emphasis is placed on cost containment, outcome, and efficacy, the need for evidence-based clinical procedures becomes increasingly important. This need is echoed in the goals of the EHDI programme as set out by the HPCSA, specifically the goal of determining quantifiable goals and quality indicators for the monitoring and evaluations of the EHDI programme and the periodic reviews recommended to assure the quality of these programmes (HPCSA, 2002: 4). The technological growth in the field of audiology has led to an increased need for communication among professionals (Martin & Clark, 2003: 95). In line with the HPCSA's recommendations and in order to promote communication between South African audiologists with regard to the fitting of amplification for infants with hearing loss, the aims of this study

were formulated. The present study is designed to investigate the nature of EHI and support services rendered to the paediatric population by South African audiologists. The evidence gathered might serve to open up communication between audiologists serving infants with hearing loss in South Africa, and might ultimately serve as a baseline for establishing guidelines to guide service delivery to this special population.

The aim of this chapter is therefore to provide a complete exposition of the research methodology followed in the study. Methodology refers to the body of rules employed by a science (Longman Family Dictionary, 1984: 432). The following figure, figure 3.1, serves to summarise the operational framework for gathering research data as described in this chapter.

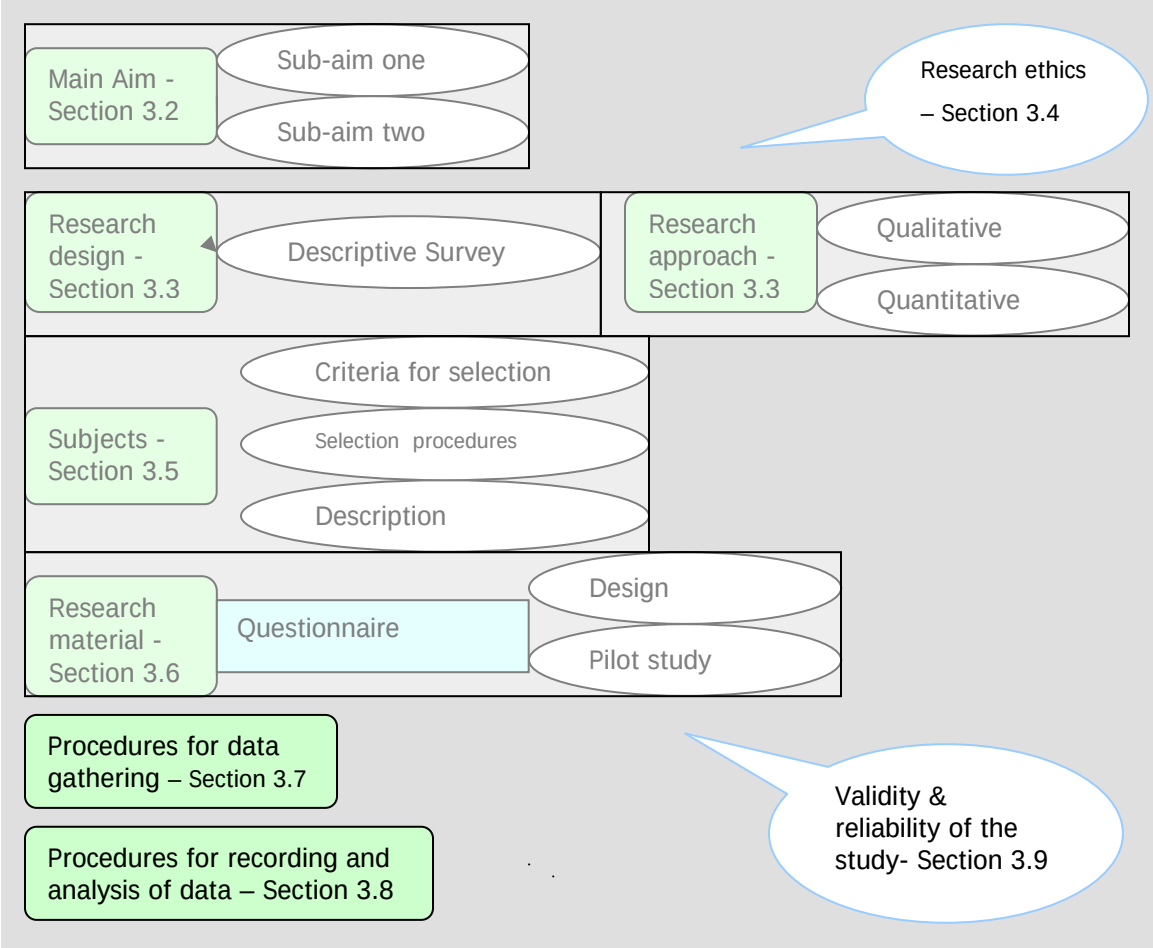


Figure 3.1 Summary of the chapter content

According to figure 3.1 the main aim, as well as the sub-aims formulated to realise the main aim will be discussed firstly. The research approach (qualitative/ quantitative) and the research design will be described. Subjects will be depicted in terms of the criteria for selection, selection procedures and characteristics. Research material (the questionnaire) will be described in view of its design and the pilot study. Procedures for gathering the data as well as recording and analysis of the data will be explained. Issues regarding the research ethics and validity and reliability of the study encompass all phases and characteristics of the research and will be highlighted.

3.2 AIMS

The aim of the research study was as follow:

The *main aim* of this study was to determine whether South African audiologists provide EHI and support services aligned with international professional best practice to infants and young children following the diagnosis of hearing loss.

The following sub-aims were formulated in order to realise the main aim of the study:

- *Sub-aim one* was to *determine the nature and scope of intervention and support services*, following the diagnosis of hearing loss, by South African audiologists.

- *Sub-aim two* was to *evaluate the early hearing and support services* rendered to the paediatric population by South African audiologists *against international professional best practice protocol.*

3.3 RESEARCH DESIGN

The approach used for the purpose of this study was *qualitative* analysis combined with *quantitative* analysis. A *qualitative* analysis allows the description of specific facets and characteristics of the audiologists' practice procedures used during service delivery to infants with hearing loss (since the researcher cannot include all possible answers) (Leedy 2001: 101). "To answer some research questions, we cannot skim across the surface. We should dig deep to get a complete understanding of the phenomenon we are studying. In qualitative research, we do indeed dig deep: We collect numerous forms of data and examine them from various angles to construct a rich and meaningful picture of a complex, multifaceted situation" (Leedy, 2000: 147). This quotation stresses the benefits of a qualitative analysis for this study. By gathering qualitative information the researcher were able to describe certain characteristics of the early hearing and support services rendered to the paediatric population by South African audiologists that might have been difficult to quantify due to the fact that the researcher cannot provide for all possible answers. Additional qualitative information about the audiologists' educational needs and the unique difficulties they experience, for instance, could be gathered and described in this way.

The research design provides the overall structure for the procedures that the researcher follows, the data that the researcher collects and the data analyses that the researcher conducts (Leedy, 2001: 91). The research design serves as a bridge between the research question and the implementation of the research (Durrheim, 2000, as cited in Leedy, 2001: 91).

To determine the nature of EHI and support services to the paediatric population by South African audiologists a *descriptive, survey analysis* was selected as research design with quantification where possible. A *questionnaire survey* was used to collect relevant data. "Survey research is a general label applied to a

variety of different research methods that share a common purpose. Survey research involves "*obtaining information directly from a group of individuals"* (Dane, 1990: 120). The questionnaire that was compiled and used for this survey will be discussed in more detail in section 3.6 and is included in appendix one.

For a *quantitative analysis* of the early hearing and support services to the paediatric population by South African audiologists, inferential statistical analysis of the data, where possible, were done (Leedy, 2001: 103). Inferential statistics made it possible to interpret results by comparing it to other results. By using quantitative analysis possible correlations between variables could be investigated.

In combining quantitative and qualitative methodologies it is possible to learn more about the phenomenon than when the researcher is limited to only one approach (Leedy, 2001: 101). This approach is also referred to as the *triangulation of method.* The latter can be used to combine a variety of different methods (qualitative and quantitative) in order to investigate and describe the specific phenomenon (De Vos, 2002, as cited in Pottas, 2004: 86). Thus, by combining qualitative and quantitative research methodologies the researcher gained insight into the nature of intervention services to babies and young children with hearing loss by South African audiologists, compared the data with international best practice guidelines and benchmarks, developed new perspectives and discovered some of the problems that exist within the field (Peshkin, 1993, as cited in Leedy, 2000: 148). This research design ensured the realisation of the research aims and is defined as applied research as practice behaviour of South African audiologists is evaluated (Mouton, 2001: 107).

3.4 RESEARCH ETHICS

"The ethics of science concerns what is wrong and what is right in the conduct of research" (Mouton, 2001: 238). Intrinsic to scientific research is "epistemic imperative" or the moral commitment of the researcher to search for truth and knowledge (Hyde, 2005: 298). This translates into certain conventions, e.g. objectivity and integrity in research, the fact that scientists should not change their data or observations to misrepresent facts or to mislead others, that methodology and techniques of analyses should be disclosed, that publishing practice should be ethical e.g. appropriate ascription of authorship to publication, rejecting any plagiarism and no simultaneous submission of manuscripts (Mouton, 2001: 239; Leedy, 2001: 108).

The proposal for the current study, including the motivation and the proposed methodology, was submitted and approved by the Ethical and Research Committee of the Department of Communication Pathology and the Faculty at the University of Pretoria (see the appendix two for the letter of ethical clearance as well as the title registration form). In this study the conduct of South African paediatric audiologists were studied using a questionnaire. This involved the acquisition of information provided on the basis of mutual trust. It was thus essential that the rights, interests and sensitivities of the South African audiologists participating in the research would be protected. These are the right to privacy, the right to anonymity and confidentiality, the right to full disclosure about the research (informed consent) and the right not to be harmed in any way (Mouton, 2001: 243). In this study participation was voluntary. The audiologists had the right to refuse to complete the questionnaire. They had the right to refuse to answer any of the questions in the questionnaire. The audiologists had the right to confidentiality. A cover letter detailing the purpose of the research accompanied each questionnaire (see appendix one). Despite attempts to preserve anonymity, many respondents voluntarily included

identifiable information such as names and e-mail addresses. Information was thus handled in a confidential manner. The cover letter also clearly representing the aim and benefit of the research, got informed consent, assured their confidentiality, thanked them for participating and finally offered a summary of the research results in adherence to the audiologists' right to full disclosure.

Finally, concerning the motivation of this study, it can also be argued that the search for evidence regarding the EHI service delivery to infants with hearing loss by South African audiologists is ethically driven. Interventions based on scientific evidence are intrinsically more respectful of the principle of autonomy, because in the absence of such evidence there can be no valid statements of benefits and harms that underlie informed choice (Hyde, 2005: 298). Ethically there is also an obligation to maximise overall beneficence (relates to doing good) and non-maleficence (relates to the avoidance of doing harm), and it is widely believed that scientific evidence is a more valid approach to that end than practices based on clinical intuition (Hyde, 2005: 298).

3.5 SUBJECTS

It was stated clearly in the main aim of the study that services rendered by *South African audiologists* will be described. In the next sections the criteria, material and procedures that were used to select the subjects for this study will be described. Finally audiologists who eventually participated in the research study will be described.

3.5.1 Criteria for subject selection

A sample is defined as a portion of the elements in a population (Dane, 1990: 289). In this study the population under investigation was the South African audiologists working with babies and young children during early hearing identification and intervention services. Traditionally speech language therapy audiology constituted a combined qualification offered by SA universities and therefore registration was done as speech language therapists and audiologists. Recently university courses have changed allowing qualification as a therapist, audiologist or both. Audiologists selected needed to be registered with the HPCSA as audiologists, or speech language therapists and audiologists and had to be working with the paediatric audiology units in private as well as government hospitals or clinics, educational centres with audiology departments, hearing aid companies with in-house audiologists and testing facilities, schools for children with hearing loss and deaf children and private practices were selected. Audiologists selected needed to be competent in either Afrikaans or English as those were the languages in which questionnaires were available. It seems that most audiologists currently in South Africa speaks either Afrikaans or English as their mother-tongue as it is estimated so far that only a small percentage of mother-tongue speakers of an African language have qualified as audiologists (Uys & Hugo, 1997: 24).

3.5.2 Material and procedures for the selection of the subjects

Material that were used for the *selection of the subjects* were the South African Association of Audiologists (SAAA, 2004) private practitioner's booklet, HPCSA list of registered audiologists (HPCSA, 2003), DEAFSA information booklet (2004) and the list of approved health facilities for community service in audiology.

The following *procedures* were used for the selection of subjects: Audiologists' names and addresses were retrieved from the material. The identified institutions were contacted telephonically for names of the audiologists primarily involved in the EHI programme. The name and address list (e-mail as well as fax numbers) were compiled accordingly. Sending the questionnaires to all audiologists might have led to a lower response rate, as several audiologists in the same service might have collaborated to send in a single response as described by Bamford (2001: 330). It might also have led to disproportionate sampling when more than one audiologist from a centre completed the questionnaire and none from another centre (Babbie, 1989:198). An inadvertently disproportionate sample might lead to an incorrect conclusion. Therefore only one questionnaire was sent out per institution or clinic. This insured that the distribution of services could be described and possible trends in the variation of EHI services could be gathered this way.

3.5.3 Description of subjects

Audiologists that were selected for this survey were registered with the Health Professionals Council of South Africa (HPCSA). The following institutions were selected for this study:

- private practices and private hospitals;
- government hospitals or clinics with audiology;
- universities or educational centres with audiology departments accredited by the HPCSA;
- hearing aid companies with in-house audiologists and testing facilities;
- schools for children with hearing loss and deaf children with audiologic facilities.

Questionnaires were sent to institutions in eight provinces of South Africa: Western Cape, Northern Cape, North West, Mpumalanga, Free State, Eastern Cape, Kwazulu-Natal and Gauteng. There were no audiologists from Kwazulu-Natal who participated.

Subjects were described according to their qualification, the university they graduated from, the year they graduated and the sector they work in. These results will be illustrated in figure 3.1, figure 3.2, figure 3.3 and figure 3.4 in table 3.1. Table 3.1 summarises the information obtained.

Table 3.1 Description of subjects

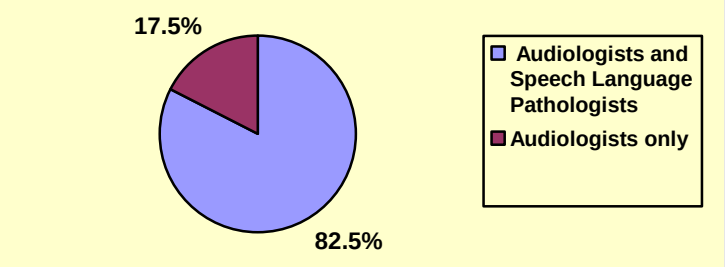
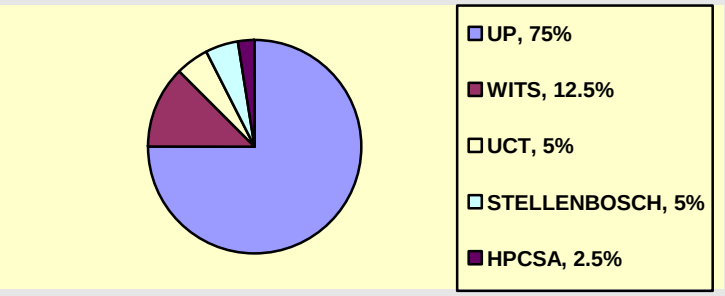
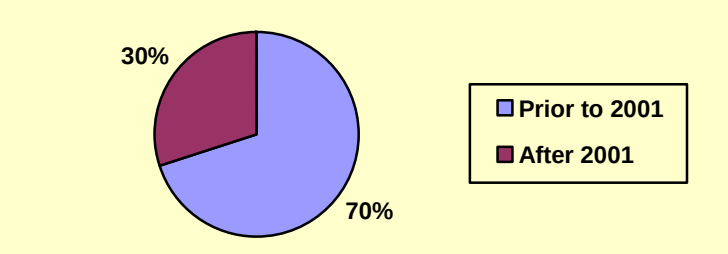
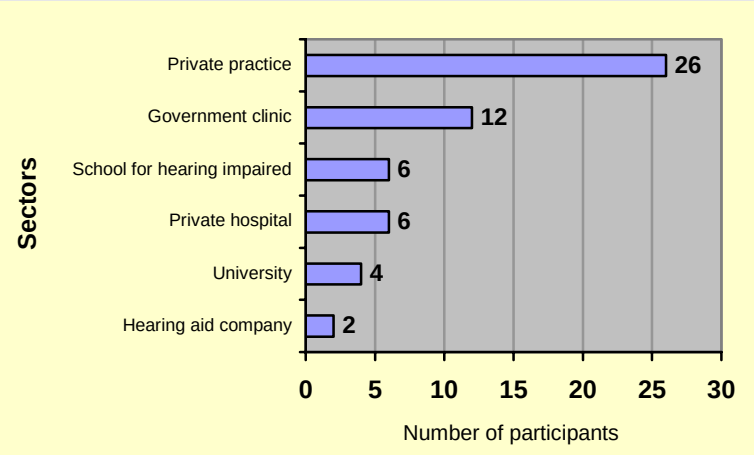
Description:	Graph indicating the different characteristics of the respondents:
Most respondents were trained as audiologists as well as speech language pathologists. Seven respondents were trained as audiologists only. (of the seven audiologists, one respondent indicated that she/he was trained as a audiometrician initially, and did the HPCSA upgrade exam)	 **Figure 3.2 Qualification of respondents (n=40)**
Three quarters of the respondents (n=30) received their training from the University of Pretoria.	 **Figure 3.3 Universities where respondents received undergraduate training (n=40)**

Table 3.1 Continued

Description:	Graph indicating the different characteristics of the respondents:
Course content at the universities changed after 2001 and respondents were thus divided to make inferential statistics possible. The distribution of respondents who qualified prior to and after 2001 is shown in the following graph. The majority of respondents graduated prior to 2001.	 **Figure 3.4 Graduation before and after 2001 (n=40)**
Results from figure 3.4 indicate that most respondents work in a private practice. • Private practice • Government clinic/ hospital • School for the hearing impaired • Private hospital • University • Hearing aid company	 **Figure 3.5 The distribution of respondents in the different working sectors (n=40)**

From table 3.1 it is clear that most respondents (more than 80%) were trained as audiologists as well as speech language pathologists, three-quarters (75%) received their undergraduate training at the University of Pretoria (UP), most of the respondents (60%) work in private practices followed in numbers by respondents working in government clinics (30%). This distribution seems to be a true reflection of the current status of the working environments of South African audiologists. The vast majority of audiologists in South Africa is in private practice and provides services to a small minority of the country (Swanepoel, 2005: 131). Due to the small numbers of respondents working in some sectors it was not

possible to do inferential statistics to investigate a correlation between the working sectors of respondents and some of the aspects investigated in the current study.

3.6 RESEARCH MATERIAL

The material and instrumentation refer to the physical instruments used during the study to gather the relevant information (Leedy, 2001: 196). The material include: Material for the selection of subjects (as discussed in section 3.5.2), material for the gathering of data, material for the recording of data and material for the analysis of data. For the *gathering of relevant data* a questionnaire was constructed and will be discussed in detail in the following section.

3.6.1 Questionnaire

Currently, to the author's knowledge, there is no relevant existing instrumentation or protocol for evaluation of early hearing services to the paediatric population in South Africa. Two documents with principles relevant for EHI exist in South Africa. These are the Professional Board for Speech, Language and Hearing Professions' HSPS (2002: 1-8), and the Standards of Practice in Audiology (2002: 1-4). These documents endorse the evaluation of services to assure quality EHDI programmes and include some suggestions regarding the procedures necessary for the fitting of hearing aids (HPCSA, 2002: 2). Guidelines necessary to assure consistent service delivery to all infants with hearing loss are limited with regard to all aspects of the EHI programme, however. In 2001, Bamford (pp. 329-338) described a survey that investigated the status of very early audiology service provision in the United Kingdom (UK) at that time. He designed two instruments to provide a measure of the quality of service provision delivered by paediatric audiology services in the UK. He

refers to these instruments as the PASI (the Paediatric Audiology Service Index) and the DEESI (Deaf Education Early Service Index). These instruments were specifically designed with UK service providers in mind (Bamford, 2000: 330) where service delivery is very different from South Africa. These two questionnaires were based on the service targets and guidelines set out in the National Deaf Children's Society (NDCS) *Quality Standards in Paediatric Audiology* (NDCS, 1994 & 1996, as cited in Bamford, 2000: 330) and the *Quality Standards in the Early Years* (NDCS 1994 & 1996, as cited in Bamford, 2000: 330). These guidelines were developed for use by audiologists and service providers in the UK. They will therefore not be effective as tools to evaluate service delivery to the paediatric population in South Africa, but can serve as a guideline in the development of a more specific assessment tool.

3.6.1.1 Questionnaire design

To be able to describe and evaluate the nature and scope of services to the paediatric population by South African audiologist a questionnaire focusing on the unique South African situation was developed by the researcher (see appendix one). As motivated in chapters one and two, benchmarks against which the EHI and support services to children with hearing loss in South Africa may be gauged, were defined and categorised (see table 2.3). Benchmarks were gathered from the international evidence base. The NDCS (United Kingdom) Quality Standards in Paediatric Audiology (NDCS, 2000: 1-24), the NDCS Quality Standards in the Early Years (NDCS, 2002: 1-29), the JCIH Year 2000 Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programs (2000: 9-29), Amplification for Infants and Children with Hearing Loss (The Pediatric Working Group, 2000: 53-68), American Academy of Audiology (AAA) Pediatric Amplification Protocol (2004: 1-19) and other relevant literature were used to compile international best practice

guidelines. Benchmarks of the EHI process are categorised using the six M variation categories.

These benchmarks delineate good quality EHI services and constitute the questions that were asked in the questionnaire of this study. The main aim of this study was to determine whether South African audiologists provide EHI and support services aligned with international professional best practice to infants and young children following the diagnosis of hearing loss. The benchmarks then, as set out in table 2.3, motivate the specific questions asked in the questionnaire. The following table summarises the design of the questionnaire. *(The questionnaire is included in appendix one).*

Table 3.2 Design of the questionnaire

Questions:	EHI service targeted with the question:	Reason for inclusion:	Literature reference in chapter one or two:
Questions 1 to 7 *Man*	Questions relating to the *audiologist.*	These questions describe the training, level of experience and knowledge of the paediatric audiologist.	Section 2.3.1 The audiologists should have experience with the assessment and management of infants with hearing loss and the commensurate knowledge (The Pediatric Working Group, 1996: 53).
Questions 9 and 10 *Man*	Questions relating to the *infant* with hearing loss	These questions reveal the amount of infants in the EHI programme and the age of diagnosis of hearing loss	Section 2.3.2.2
Questions 18 to 20 *Man*	Questions regarding the fitting of amplification for *infants* with permanent *hearing loss*	These questions reveal how soon after confirmation of hearing loss children with hearing loss are fitted with hearing aids and whether they are fitted binaurally.	Section 2.2 Section 2.3.3.1.1

Table 3.2 Continued

Questions:	EHI service targeted with the question:	Reason for inclusion:	Literature reference in chapter one or two:
Question 12 *Man*	Questions relating to the role and responsibility of the *family* or caregivers.	These questions reveal whether the parents and family of the child with hearing loss are involved in the EHI programme and the nature of the involvement.	Section 2.3.2 Services should be responsive to the needs of every child with hearing loss and their family if the support provided is to be effective (Bamford, 2002; 157).
Questions 13 and 14 *Man*	Questions regarding sharing information with the *family* regarding all facets of the intervention plan	These questions reveal the way in which information is given to the parents by South African audiologists e.g.: Do they receive written information and how regular?	Section 2.3.2.1 Parents need: • Information about intervention options • Information about hearing aid care and maintenance • Information about services available in their communities • Written information (Roush & Harrison, 2000: 159-164)
Questions 15 and 16 *Man*	Questions regarding the method of planning, delivering and reviewing intervention and support to the infant with hearing loss and his/ her family.	Information regarding the planning of EHI services, which would include factors such as the time of availability of the EHI service, whether individual family differences are taken into account in the EHI programme	Section 2.3.3 Eco-cultural theory refers to consideration of the socio-cultural environment of the child and family (Diefendorf et al, 1996: 132)
Question 11 *Man*	Questions relating to the EHI programme *multi-professional team*	These questions reveal whether the audiologist works in a multidisciplinary team, and the nature of this team	Section 2.3.3.2 The success of the EHI programme depends on the professionals working in partnership with families in a well-coordinated multidisciplinary team (JCIH, 2000: 12)
Question 8 *Systematic procedures/ Method*	Question regarding the EHI programme	This question reveals the specific components that form part of the EHI programme	Section 2.3.3

Table 3.2 Continued

Questions:	EHI service targeted with the question:	Reason for inclusion:	Literature reference in chapter one or two:
Question 33 *Systematic procedures/ Method*	This question involves the follow-up visits of infants with hearing loss and their families.	This question reveals all the components that are included in the follow-up visits of infants with hearing loss and their families	Table 2.3.
Questions 34 and 35 *Systematic procedures/ Method*	These questions involve the communicatio n assessment and training/ auditory rehabilitation services	These questions reveal whether communica-tion assessment and training are included as part of the EHI services to the infants with hearing loss and their families. If not, reasons are revealed.	Section 2.4.1 Without appropriate opportunities to learn language, children with hearing loss will fall behind their hearing peers in language, cognition and socio-emotional development (Yoshinaga-Itano, 1998:161-170).
Questions 31 and 32 *Systematic procedures/ method*	Questions regarding the method of ongoing audiological and amplification monitoring	These questions reveal the frequency of monitoring the hearing loss as well as the fitting	Section 2.4.2.1 The importance of reliable accurate hearing thresholds is undeniable, as an error in threshold estimate can lead to the wrong assignment of gain (Kuk & Marcoux, 2002: 504).
Questions 36 and 37 *Systematic procedures/ Method*	These questions involve the method of monitoring the quality of all components of the EHI programme	This question reveals whether quality monitoring forms a part of the EHI programme and if it is performed, the method used to monitor quality of the EHI programme.	Section 1.2 EHI services should be evidence-based and quality monitoring should be a key aspect of this service provision. (Bamford, 2001:329)
Questions 21 to 28 *Measurement*	Questions regarding the verification and validation of the hearing aid fitting	These questions reveal the kinds of measurements done when fitting hearing aids to children for verification and validation of the fitting, e.g. probe microphone measurements.	Section 2.4.2.1 "Facilities that lack the expertise or equipment should establish consortial arrangements with those that do", (The Pediatric Working Group, 1996: 53). "Without current technology or viable agreements between centers, the practice of pediatric audiology should be discontinued". (Gravel, 2001: 44).

Table 3.2 Continued

Questions:	EHI service targeted with the question:	Reason for inclusion:	Literature reference in chapter one or two:
Questions 29 to 30 *Equipment/ Material*	These questions involve the physical characteristics of the hearing aids fitted for infants with hearing loss. It also includes assistive listening devices, ear moulds and miscellaneous material.	These questions reveal the frequency with which specific features or technologies in the hearing aids, and other devices are included when fitting infants with hearing loss with amplification.	Section 2.4.2.1 Table 2.2 Selection of the hearing aids involves the finding or adjusting of the hearing aid to match the prescription as closely as possible (Boothroyd, 2002: 6)
Question 17 *Mother Nature*	This question supplies information about the unique factors that influence the EHI programme.	Factors such as financial constraints, cultural diversity etc are rated in terms of the frequency with which they influence service delivery to infants with hearing loss.	Table 2.3. In a third world country such as South Africa the socio-cultural environment will possibly have the greatest influence on an EHI programme (Hugo, 1990: 3)

Some practical guidelines were drawn from the literature when the questionnaire was compiled (Converse and Presser, 1988: 1-48). These included:

- specific questions are better than general ones: In order to quantify results the researcher attempted to ask specific questions where possible to make comparison possible;
- open questions – they are preferred where not enough is known to write appropriate response categories: for this study the researcher used only a few open questions to supplement questions (e.g. the respondents needed to explain their method of quality monitoring), mostly closed questions were asked;

- omitting the middle alternative when measuring frequency: Four alternatives were given where frequency or intensity was measured (e.g. always, frequently, seldom and never);
- consideration of the wording and order of questions.

Converse and Presser (1988: 48) summarise: "Every questionnaire must be handcrafted. It is not only that questionnaire writing must be 'artful', each questionnaire is also unique, an original. A designer must cut and try, see how it looks and sounds, see how people react to it, and then cut again, and try again."

Finally, the necessary steps to increase the return rate for this study. The typical return rate for a mailed questionnaire is 50% or less, and in recent years it has steadily declined (Rogelberg & Luong, 1998, as cited in Leedy, 2000). Leedy (2000: 206) gives the following guidelines to increase the return rate: Consider the timing, make a good first impression, motivate potential respondents, include a self-addressed envelope with return postage, offer the results of the study, and be gently persistent. These guidelines are echoed by Dillman's Total Design Method (1978, as cited in Dane, 1990: 134) that provides practices designed to increase response rate. This Total Design Method involves making the instrument well-organised and easy to complete and it attempts to reward the respondents by offering them copies of the research results. After "handcrafting" the questionnaire as described, it was piloted to test the respondents' reaction to the questionnaire.

3.6.1.2 Pilot study

Pre-testing or piloting involves giving a draft of the questionnaire to a small group of people. The purpose of the pilot study is not to make a test run of the entire research procedure, it is only a test for the specific questionnaire that will

be used (Dane, 1990: 127). Due to the theoretical nature of the questionnaire it was important to pre-test the practicality of the questionnaire. A "participating" pre-test were used (Converse and Presser, 1986: 52). This is where respondents are told that this is a practice run and are asked to explain their reactions and answers. The pre-test information can be divided into questions about the specific questions of the questionnaire, and questions that bear on the questionnaire as a whole (Converse and Presser, 1986: 55).

Questionnaire questions were pre-tested in terms of their content, whether terminology was clear or understood, task difficulty, the respondent's interest and attention. The questionnaire was tested in terms of its flow and naturalness, the order of questions, typographical errors and the logic and format of skip patterns, the time it takes to complete the questionnaire and finally respondents' interest overall (which bears on the ethics of the questionnaire) (Converse and Presser, 1986: 53-65). The ease of coding and the strategies for analysis was also tested (Pottas, 1998: 74).

For the pilot study, questionnaires were given to South African audiologists representing the different environments where babies and young children are typically tested. For this study one representative from private practice, a representative from a private hospital and hearing impaired school and a representative each from a provincial hospital and academic institution were selected. There were three pre-test questionnaires. Two questionnaires were e-mailed, feedback from these two respondents was received via e-mail as well as telephonic conversation, and one pre-test questionnaire was completed with the researcher present. The respondents of the pilot study were excluded from the main study. The following table 3.3 summarises the results from the pre-test.

Table 3.3 Pilot study (results one to ten)

Aims:	Results/ recommendations:	Changes to the questionnaire:
1. Evaluating the questionnaire content	• Some questions regarding the training and qualifications of audiologists were problematic as it did not specify whether the researcher referred to undergraduate or postgraduate training. • There were no questions relating to the experience of audiologists in this field. • Some questions regarding the specific EHI tasks were confusing as they were not separated. • Audiologists were asked to specify the number of infants they enroll in an EHI programme per month. Participating audiologists reminded the researcher that typically very few infants are enrolled per practice and that respondents should rather be asked to indicate the number of infants enrolled in EHI programmes per year. • Respondents were asked to rate the "importance of parent participation in the EHI programme". This was regarded as a theoretical question and did not reflect on practice behaviour.	• These questions were clarified by extending it over three questions specifically referring to the level of training it needed to reflect on. • Questions about the experience level of audiologists were included. • Questions relating to different areas of EHI were separated. • The question was changed according to the recommendation of the respondents. • The "importance of parent participation" was changed to "parent involvement".
2. To evaluate whether terminology was clear or understood	• Some new terminology was confusing e.g.: Real Ear to Coupler Difference (RECD) and the participating audiologists had no knowledge in that area. • The researcher did not consistently use the same terminology e.g.: babies, then infants	• Where multiple options were given, an option "no knowledge" was given. • Terminology was changed to be consistent.

Table 3.3 Continued

Aims:	Results/ recommendations:	Changes to the questionnaire:
3. Task difficulty was evaluated	• Two questions were identified that were ambiguous. These questions related to the areas of EHI that the respondents were trained in and their rating of the significance of the training. Respondents were unsure whether the training referred to undergraduate training specifically. • Overall questions were easy to understand although they involved current tendencies in EHI.	• These two questions were changed. • It was now asked of respondents to indicate whether they had received undergraduate training. • The different sources of knowledge in EHI were specified for rating of their significance.
4. Evaluating respondent's interest	• Audiologists reported interest in the content of the questionnaire and were curious to know what the study outcomes would be. • The questionnaire needed constant thinking and rethinking of ideas and audiologists reported fatigue and poorer attention span nearing the end of the questionnaire.	• Some questions were combined to shorten the questionnaire and questions demanding current knowledge were moved to the beginning of the questionnaire.
5. Evaluating the flow and naturalness of questions	• Overall the questions seemed to have a natural progression and responding audiologists reported an easy flow.	
6. Evaluating the order of questions	• Questions were identified that needed to be asked earlier in the questionnaire.	• The order of questions was changed according to the recommendations.
7. Typo-graphical errors	• A few spelling and typing mistakes were identified.	• Spelling and typing errors were corrected
8. Evaluating the logic and format of skip patterns	• Numbering was incorrect at some skip patterns (e.g.: If you said no, then…) and was misleading.	• Numbering was corrected.
9. Completion time	• All the responding audiologists reported that it took 25 minutes to complete the questionnaire.	• The order of some questions was changed to shorten the time it takes to complete.
10. Reporting on the ease of coding	• The researcher coded the pre-tested questionnaires. • Coding were easy and accurate	• No changes were made

This table summarised all the results obtained from the pilot study and the changes made to the final questionnaire based on these recommendations.

3.7 PROCEDURES FOR THE GATHERING OF THE DATA

The information and feedback from the pilot study were used to formulate the final questionnaire. Questionnaires were sent out with a motivational letter in July 2004. (The cover letter, both Afrikaans and English, are included in appendix one). In order to eliminate the problems associated with mail questionnaires (time-delay, lost mail etc), questionnaires were sent via e-mail or fax to the audiologists selected. Completed questionnaires were e-mailed or faxed back to the researcher. A summary of the results will be sent to respondents who enquire about the results. As it was mostly filled in anonymously, the researcher does not know who returned the questionnaires and cannot send the results unless there is an inquiry.

Forty of the 90 questionnaires were returned which equals a 44% return rate. Hyde, (2005: 289) warns that a return rate of less than 80%, though commonplace, limits the generalisability of the findings. He concludes that studies with a return rate of less than 80% should not be disregarded, but that sources of bias and the limitations to generalisability should be carefully analysed. It is thus essential not to generalise the findings of this study to all audiologists in South Africa providing EHI services to infants, but limit reference to the respondents of this survey.

3.8 PROCEDURES FOR THE RECORDING AND ANALYSIS OF DATA

The method of analysis that was used for this descriptive study was exploratory in nature (Dane, 1986: 138). It includes frequency displays and measures of central tendency and variability. For the purpose of this study inferential statistics appropriate for nominal data were used. Fishers' Exact Test (Fischer, 1935) was used to determine if there were non-random associations between two categorical

variables. Fisher's Exact Test (Fischer, 1935) is based on exact probabilities from a specific distribution and is often used in situations where a large sample approximation is inappropriate (Weisstein, 1999: 1). Because of the small sample size of this survey, it was an appropriate test. Very few correlations existed with a higher than 90% confidence level (probability (p) value of 0-05-0.1) and it was thus selected to interpret a statistical correlation for the purposes of this study. The 90% confidence interval is the range of effect sizes you would expect to measure for 90 out of 100 replications of the study (Weisstein, 1999:1). The means procedure was also used for some variables and to establish the central point around which the data revolve, or the point of central tendency (Leedy, 2001: 264). Mathematically the mean is the arithmetic average of the scores within the data set (Leedy, 2001: 264). This is appropriate for data on an interval scale. Finally, open questions were described using qualitative content analyses. The researcher was assisted in this regard by the Department of Statistics at the University of Pretoria.

3.9 VALIDITY AND RELIABILITY OF THE STUDY

The validity of the instrument used in this study (the questionnaire in this case) and the validity of the research process determine the reliability of this study. In general, the validity of a measurement instrument is the extent to which the instrument measures what it is suppose to measure (Leedy, 2001: 98). Validity takes on different forms. The validity that describes this questionnaire is criterion validity. According to Leedy (2001: 98) this kind of validity is the extent to which the results of an assessment instrument correlate with other related measures. In the case of this study the results from the questionnaire were compared to best practice guidelines gathered from the international evidence base. Fundamental to the validity of this questionnaire the international best practice guidelines derived from the international evidence base by the researcher should be a true reflection

of what is universally accepted as best practice in EHI services. The guidelines as compiled by this researcher (table 2.3) were compiled from and compared to existing guidelines such as the NDCS: Quality Standards in the Early Years: Guidelines on working with deaf children under two years old and their families (NDCS, 2002) and Quality Standards in Paediatric Audiology: Guidelines for the Early Identification and the Audiological Management of Children with Hearing Loss (2000), the JCIH Year 2000 Position Statement: Principles and Guidelines for Early Hearing Detection and Intervention Programmes, and the American Academy of Audiology's Pediatric Amplification Protocol (2003). These guidelines are evidence-based and widely used and accepted as best practice for EHI services.

The internal validity of the research project as a whole has to do with its accuracy, meaningfulness and credibility. Questions in the questionnaire were ordered in such a way that answers in one sections could confirm answers in other sections in the hope that they would all converge to confirm a particular finding. In this study analyses were quantified where possible by using inferential statistics. Results were supplemented with qualitative open questions where necessary. The use of several research methods to test the same finding is called triangulation and can be used to test research findings and subsequently the accuracy of the findings (Babbie, 1989: 99). This bears on the internal validity of this research project.

The study's external validity is dependent on the representativeness of the sample. As the return rate was less than 80% the results cannot be generalised to the entire population of audiologists in South Africa who supply EHI services to infants with hearing loss. The results will be describing the EHI services of 40 audiologists who render EHI services to infants with hearing loss in South Africa. Trends in the service delivery to these infants can be described.

3.10 SUMMARY

In this chapter the methodology used to answer the research question was described. The aims of the study were identified. The research approach and design that were used to realise these aims were discussed. The selection of subjects as well as the procedures and material used for the selection were identified and the subjects were described. The design and construction of the questionnaire were examined as well as the procedures used for the gathering of the data and the procedures used for the analysis of the data. All issues relating to the ethics and reliability of the study were argued.

CHAPTER 4
RESULTS AND DISCUSSION

Aim: To present the results of the empirical research and to elucidate the meaning and significance thereof.

"There are some people who begin the Zoo at the beginning, called WAYIN, and walk as quickly as they can past every cage until they come to the one called WAYOUT, but the nicest people go straight to the animal they love the most, and stay there."

(Milne, 1926, in the introduction to *Winnie-the-Pooh*.)

4.1 INTRODUCTION

The above quotation from the children's book, *Winnie the Pooh*, serves as a reminder to stop and spend time with the things we regard as important. In the life of the child with hearing loss, EHI is crucial for the development of language that eventually influences their level of education and employment (Yoshinaga-Itano, 1998: 63; Gaullaudet University Centre for Assessment and Demographic Study, 1998: 75). The theoretical underpinnings for the importance of timely, accurate and comprehensive EHI services were provided in chapters one and two. Key principles that were highlighted and discussed were that paediatric service provision should be evidence-based and quality monitoring should be a key aspect of this service provision (Bamford, 2001: 329). In line with these principles the main aim of this study was formulated. The main aim of this study was to determine whether South African audiologists provide EHI and support services

aligned with international professional best practice to infants and young children following the diagnosis of hearing loss.

Chapter three presented the methodological approach that supplied the operational framework for gathering the necessary data for addressing the main aim of this study. The aim of this chapter is to describe the nature and scope of intervention and support services, following diagnosis of hearing loss, to the paediatric population by South African audiologists and to discuss it in terms of relevant and comparable literature. In figure 4.1 a presentation of the sub-aims investigated to attain the main goal of the study is provided, as *results are discussed according to these aims*.

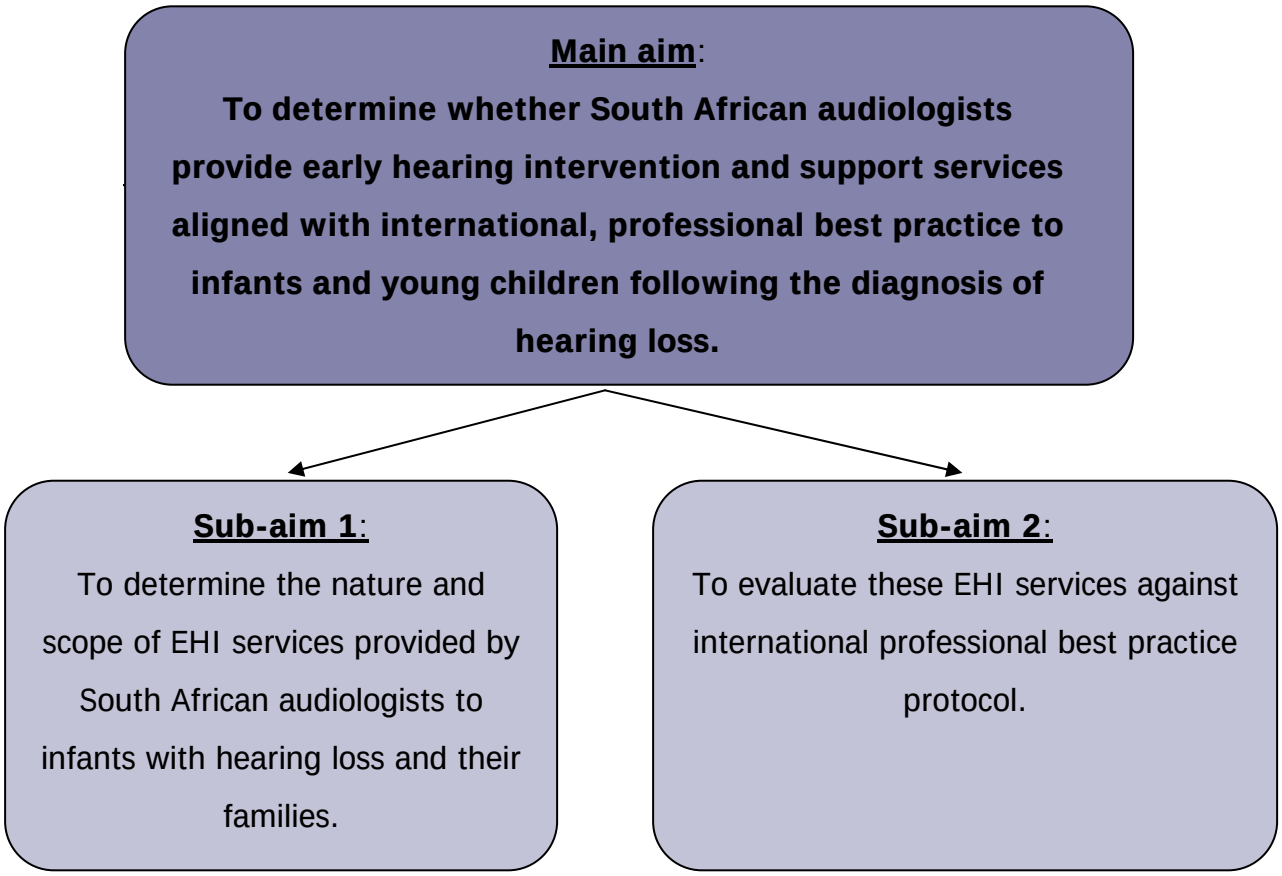


Figure 4.1 Main aim and sub-aims of this study

The descriptive results for all sub-aims will address the research question and attain the goal of the current study. According to Neuman (1997, as cited in Swanepoel 2005: 208) comparison is the key to all research and the meaning and significance of the results depend upon appropriate interpretation, relevant conclusions and generalisations based on the analysed data. The results of the current study are presented and *discussed according to the sub-aims* as specified in figure 4.1.

4.2 RESULTS OF SUB-AIM ONE

To determine the nature and scope of EHI services provided by South African audiologists to infants with hearing loss and their families

The first sub-aim of this study was to determine the nature and scope of intervention and support services to children (nought to three years) and their families, following the diagnosis of hearing loss, by South African audiologists.

In order to describe the nature and scope of the intervention and support services to children (nought to three years) and their families, following the diagnosis of hearing loss by South African audiologists, results will be discussed using the six M variation categories as explained and motivated in section 1.2, namely man, equipment (machine), method, amplification devices (material), measurement, and Mother Nature.

4.2.1 Man

This category includes everyone involved in the EHI programme. In EHI it will include the audiologist, the infant (nought to three years) with the hearing loss, the family or caregivers, and the multidisciplinary team members. As the study

concerns the nature and scope of the EHI services rendered by South African audiologists, aspects of the South African audiologist will be discussed firstly.

4.2.1.1 The South African audiologists

In the questionnaire questions one to seven related to the South African audiologists, revealing the respondents' level of experience, working sectors, areas of training as well as their perception of the training they received. In the following sector the results will be discussed and elucidated with graphs or figures where possible, and interpreted to conclude each section.

The reader is referred to table 3.1 where the characteristics of the responding audiologists are summarised. From table 3.1 it is clear that most respondents (more than 80%) were trained as audiologists as well as speech language pathologists, three-quarters (75%) received their undergraduate training at the University of Pretoria (UP), most of the respondents (60%) work in private practices followed in numbers by respondents working in government clinics (30%). This distribution seems to be a true reflection of the current status of the working environments of South African audiologists. The vast majority of audiologists in South Africa is in private practice and provides services to a small minority of the country (Swanepoel, 2005: 131). Due to the small numbers of respondents working in some sectors it was not possible to do inferential statistics to investigate a correlation between the working sectors of respondents and some of the variables investigated in the current study.

The following figure, figure 4.2, will serve as a framework for the discussion and interpretation of the results concerning the South African audiologist, with special emphasis on the respondents' perception of their training as it is seen as fundamental in the rendering of EHI services.

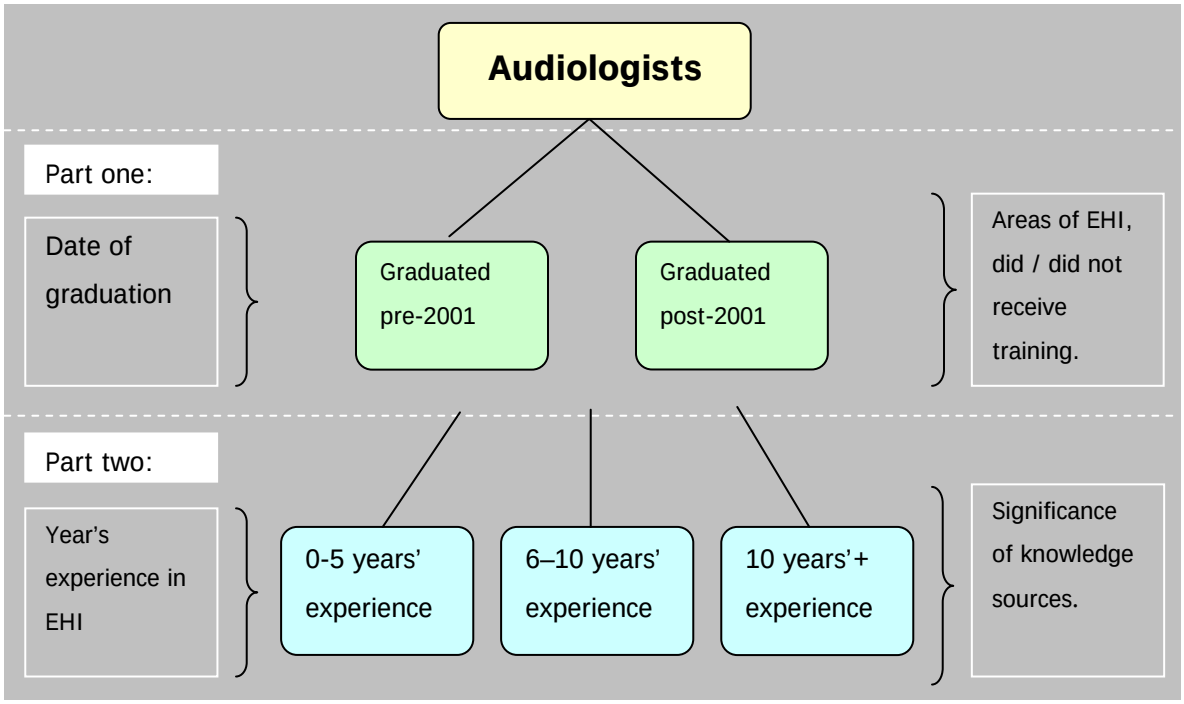


Figure 4.2 Framework for discussing and interpreting results: Training of South African audiologists

Figure 4.2 supplies the framework for the following discussion. Results of the questionnaire concerning the training of audiologists in South Africa will be presented in two parts: Part one will focus on the respondents' perception of the undergraduate course content and part two will focus on the respondents' perception of the significance of the different sources of knowledge in EHI.

4.2.1.1.1 Part one: Undergraduate training of audiologists in EHI and support services

Figure 4.3 summarises the results from question five, reflecting respondents' perception of their undergraduate training. The respondents indicated whether they received undergraduate training in the specific areas of EHI or not.
(Table one in appendix three summarises the frequencies and percentages for question five).

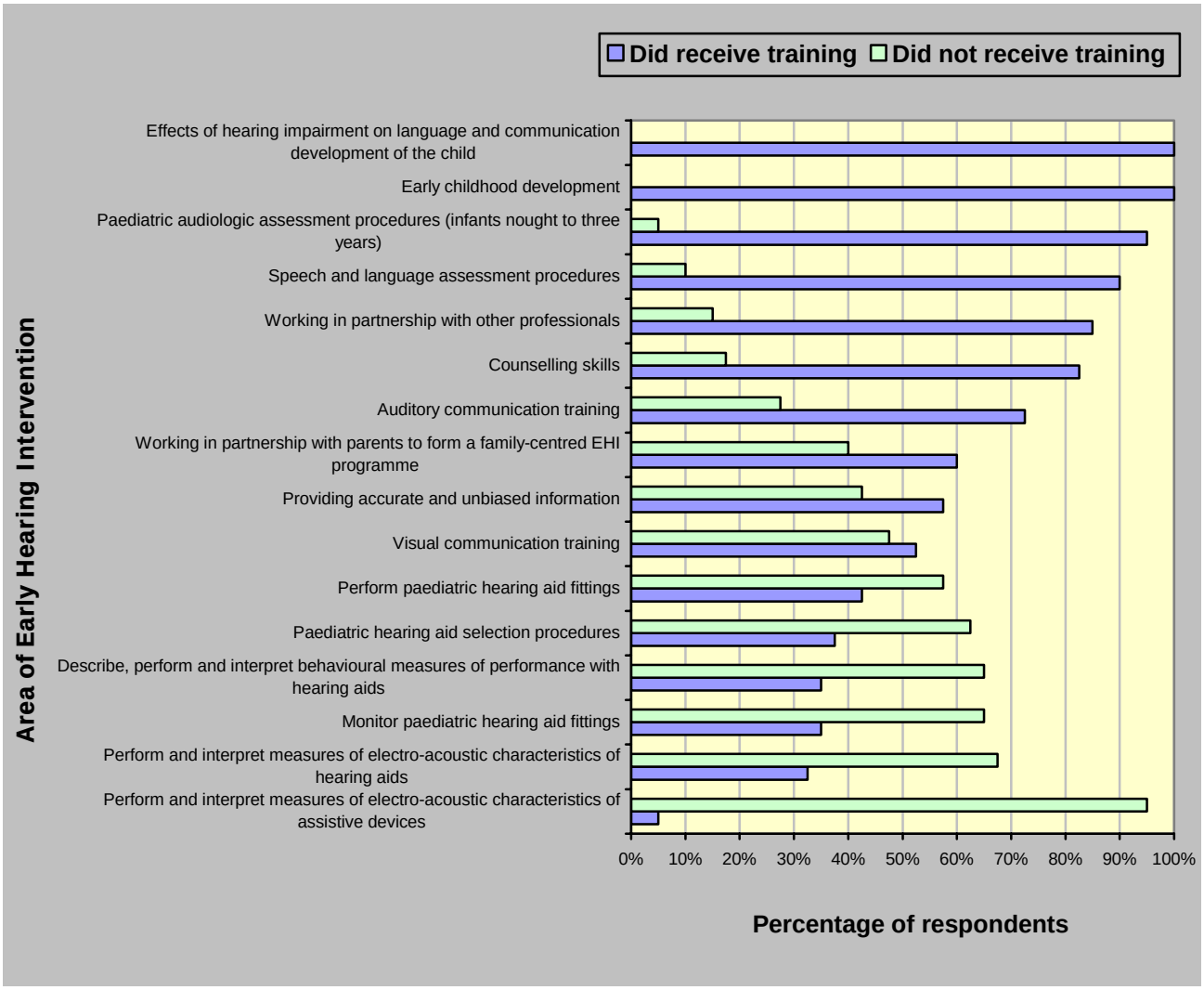


Figure 4.3 Training in specific areas of EHI and support services (n=40)

Figure 4.3 shows that *50% or more respondents indicated that they did receive training* in the following areas:

- effects of hearing impairment on language and communication development of the child;
- early childhood development;
- paediatric audiologic assessment procedures (infants nought to three years);
- speech and language assessment procedures;
- working in partnership with other professionals;
- counselling skills;
- auditory communication training;
- working in partnership with parents to form a family-centred EHI programme;
- providing accurate and unbiased information;
- visual communication training.

From figure 4.3 it is apparent that *50% or more respondents indicated that they did not receive training* in the following areas:

- performing paediatric hearing aid fittings;
- paediatric hearing aid selection procedures;
- describing, performing, and interpreting behavioural measures of performance with hearing aids;
- monitoring paediatric hearing aid fittings;
- performing and interpreting measures of electroacoustic characteristics of hearing aids;
- performing and interpreting measures of electroacoustic characteristics of assistive listening devices.

When interpreting these indicated perceptions, the most obvious interpretation is the degree of agreement within a group of respondents (Newstrom, 1987: 193). The areas of EHI where respondents' negative responses showed a high degree of agreement (more than 60%) are the following: Paediatric hearing aid selection procedures, performing and interpreting measures of electroacoustic characteristics of assistive devices, performing and interpreting measures of

electroacoustic characteristics of hearing aids, describing, performing and interpreting behavioural measures of performance with hearing aids and monitoring paediatric hearing aid fittings. Given the dominance of the negative responses (60% to 95%), these responses can be seen as a reliable reflection of the training of responding audiologists. There also seems to be a high degree of agreement among respondents (60% to 100%) that they were trained in multidisciplinary team work, the effects of hearing impairment on language and communication development of the child, speech and language assessment procedures, counselling skills, early childhood development, paediatric audiologic assessment procedures (infants nought to three years) and working in partnership with parents to form a family-centred EHI programme.

With agreement under the respondents that they were not trained in certain areas of EHI (as discussed in the previous paragraph), it is necessary to scrutinise the content of the educational programmes in order to interpret these results. In 2001 the content of the audiology undergraduate training programmes at universities in South Africa changed to divide the undergraduate programme into an audiology course and a speech language pathology course. The perceptions of the training content of these two groups will be influenced by the different syllabi. The respondents were thus divided between audiologists who had graduated prior to these changes in 2001 and after 2001. A possible correlation between the change of course content and the respondents' perception of the training content was investigated through inferential statistical analysis. Fisher's exact test (Fisher, 1935) was done to determine whether a correlation exists between *the respondents' year of graduation and their perception of their training.* A minimum confidence level of 90% (probability (p) value of 0.05-0.1) was selected as limit for the purpose of this study. The 90% confidence interval is the range of effect sizes that you would expect to measure for 90 out of 100 replications of the study.

The following table (table 4.1) summarises the results for Fisher's exact test (Fisher, 1935) for the areas of the EHI programme and the year of graduation of the respondents.

Table 4.1 Results from Fisher's exact test (Fisher 1935): Correlation between the respondents' year of graduation and their perception of training in EHI

	Area of Early Hearing Intervention	Two-sided Pr<=Table probability (P)	Correlation
1	Visual communication training	0.31	None
2	Auditory communication training Perform paediatric hearing aid fittings	1.00	None
3	Perform paediatric hearing aid fittings	0.07	90% confidence
4	Monitor paediatric hearing aid fittings	0.07	90% confidence
5	Describe, perform and interpret behavioural measures of performance with hearing aids	0.28	None
6	Perform and interpret measures of electroacoustic characteristics of hearing aids	0.47	None
7	Perform and interpret measures of electroacoustic characteristics of assistive devices	0.51	None
8	Paediatric hearing aid selection procedures	0.31	None
9	Providing accurate and unbiased information	1.00	None
10	Counselling skills	1.00	None
11	Working in partnership with parents to form a family-centred EHI programme	0.64	None
12	Speech and language assessment procedures	0.0054	99% confidence
13	Paediatric audiological assessment procedures (infants nought to three years)	1.00	None

Table 4.1 Continued

	Area of Early Hearing Intervention	Two-sided Pr<=Table probability (P)	Correlation
14	Effects of hearing impairment on language and communication development on the child	Not possible to do Fisher's exact test, 100% of all respondents indicated they were trained	n/a
15	Early childhood development	Not possible to do Fisher's exact test, 100% of all respondents indicated they were trained	n/a
16	Working in partnership with parents and other professionals	0.29	None

(In appendix three, frequencies and percentages for respondents yes or no answers concerning the training received in the performance of hearing aid fitting versus the year of graduation (table two), the monitoring of paediatric hearing aid fittings versus the year of graduation (table three) and speech and language assessment procedures versus year of graduation (table four) is supplied.)

From table 4.1 it is apparent that there was no significant difference in the way pre-2001 graduates and post-2001 graduates responded in the following areas:

- describing, performing, and interpreting behavioural measures of performance with hearing aids;
- performing and interpreting measures of electroacoustic characteristics of hearing aids;
- performing and interpreting measures of electroacoustic characteristics of assistive listening devices;
- paediatric hearing aid selection procedures.

As depicted in table 4.1 there is a correlation between training in speech and language assessment procedures, monitoring paediatric hearing aid fittings and performing paediatric hearing aid fittings and whether the respondents graduated prior to or after 2001. Subsequently the nature of the correlation between these areas and the year of graduation was analysed. Table 4.2 summarises the nature

of these correlations by using graphs to demonstrate the perceptions of the two different groups regarding undergraduate training received in these three areas.

Table 4.2 Summary of results: The nature of the correlation between respondent's year of graduation and their perception of training in EHI

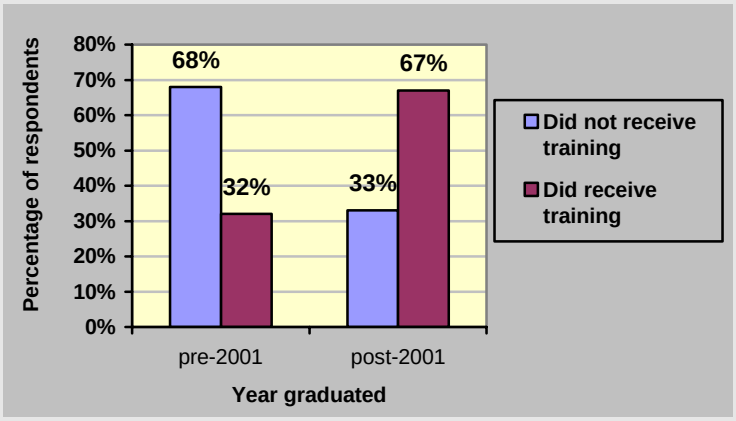
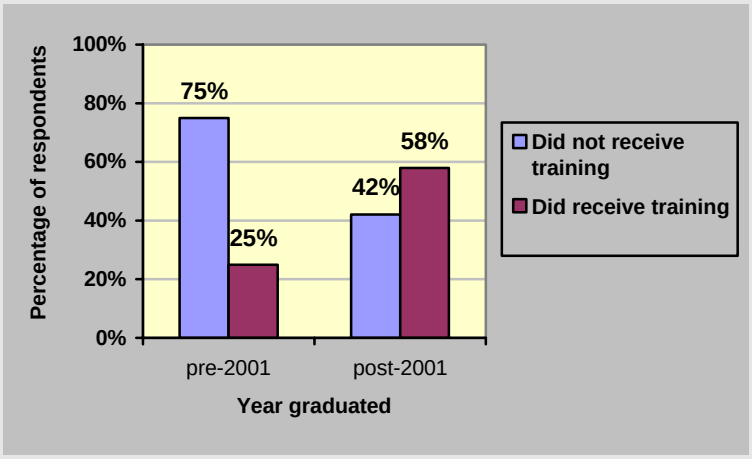
Summary of the results:	Graph indicating the nature of the correlations:
• Of the respondents who graduated prior to 2001 more than two thirds (68%) indicated that they had not received training in the performance of paediatric hearing aid fittings versus the 32% (less than one third) that marked that they had received training. Of the students who graduated after 2001 two thirds indicated that they had received training in the performance of paediatric hearing aid fittings versus the one third of respondents who graduated after 2001 who indicated that they had not receive training in this area of EHI.	 **Figure 4.4 Undergraduate training in the performance of paediatric hearing aid fittings (n=40)**
• Figure 4.5 indicates that 75% of all the respondents who graduated before 2001 indicated that they had not received training in this area of EHI. Only 25% of this group indicated that they had received training in the monitoring of paediatric hearing aid fittings. • Of the respondents who graduated after 2001, 42% indicated that they had not received training in the monitoring of paediatric hearing aid fittings versus the 58% who indicated that they had received training in this area.	 **Figure 4.5 Undergraduate training in the monitoring of hearing aid fittings (n=40)**

Table 4.2 Continued

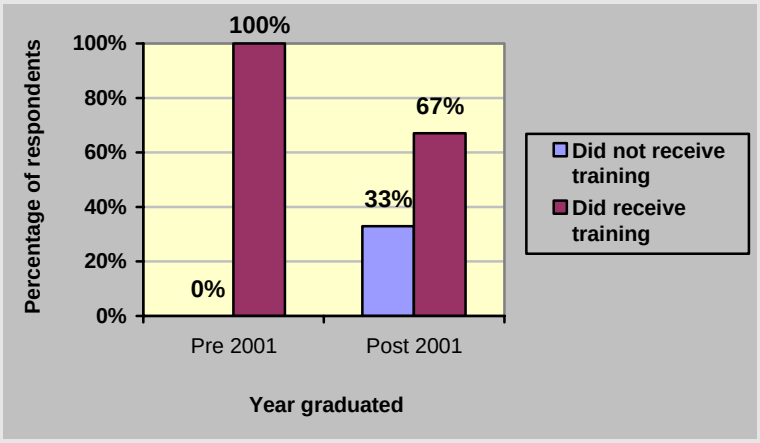
Summary of the results:	Graph indicating the nature of the correlations:
• Figure 4.6 shows that 100% of all the respondents who indicated that they had not received training in speech and language assessment procedures graduated after 2001. One third of all the respondents who graduated after 2001 (33%), indicated that they had not received training in speech and language assessment procedures. Two thirds (66%) of this group indicated that they had received training in this area. • All the respondents who graduated before 2001 indicated that they had received training in speech and language assessment procedures.	

Figure 4.6 Undergraduate training in speech and language assessment procedures (n=40)

An interesting finding according to table 4.3 is that more than two thirds of the group who graduated before 2001 indicated that they *had not received training in*:

- performance of paediatric hearing aid fittings;
- monitoring of hearing aid fittings.

Of the respondents who graduated after 2001 the majority indicated that they had received training in these areas.

The first assumption that one can make is that undergraduate training prior to 2001 did not cover these subjects. Subsequently the course contents of the Department of Communication Pathology at the University of Pretoria (UP), where the majority of respondents (75%) graduated, were investigated. The 2000 yearbook of the Faculty of Humanities, Department Communication Pathology at the University of Pretoria was used. See table 4.3 for a summary of the relevant

information from the 2000 and 2005 yearbooks of the Faculty of Humanities, Department Communication Pathology at the University of Pretoria:

Table 4.3 Subject content: Department of Communication Pathology (University of Pretoria)

Subject:	**Description (Regulations and Syllabi, Faculty of Humanities, 2000: 180):**
ODL 222:	"...Setting and adapting of hearing aids for individual clients. Special programmes and support systems for the hearing impaired child..."
ODL 322:	"Theory of communication evaluation and therapy of the paediatric population, parent-child interaction, training in speech-reading and auditory perception..."
ODL 422:	"...Intervention with the hearing impaired child with reference to: Implications of the hearing loss on the development of the child, parent counselling, fitting of hearing aids, speech-reading, support programs, the choice of the communication mode, multidisciplinary teamwork..."
ODL 482: (Practical module)	"...Pedo-audiometry..."
ODL 481: (Practical module)	"...Educational audiology: Intervention with the child with emphasis on mother-child interaction, language-, perceptual-, and communication intervention. Recommendations with regard to amplification systems. Development of an individualised intervention plan for each child that includes parent counselling..."
Subject:	**Description (Regulations and Syllabi, Faculty of Humanities, 2005: 134-137):**
ODL 222:	"...The selection of appropriate hearing aids, assistive listening devices, special consideration in children..."
ODL 311:	"...Measurement of electroacoustical properties of hearing aids. Real ear measurements..."
ODL 411:	"...The theoretical basis for intervention with the hearing impaired infant and pre-school child with special reference to: Implications of a hearing loss on the development of the child; caregiver; hearing aids; the implementation of strategies to develop the child's auditory ability; speech reading, receptive and expressive communication abilities. Special programmes and support systems; communication method; collaborating with other professionals and measuring the outcome of treatment..."
ODL 481: (Practical module)	"...Intervention with an individual child of any age regarding the following: Assessment of the hearing–impaired child; compiling an individualized intervention programme for the child and his family..."
ODL 482: (Practical module)	"...Hearing aid evaluation, selection, fitting and adaptation programmes..."

According to the 2000 yearbook of the Faculties of Humanities (Regulations and Syllabi, Faculty of Humanities, 2000: 180) it seemed that the performance of

paediatric hearing aid fittings and the monitoring thereof were included in the syllabus. Although the 2005 syllabus (Regulations and Syllabi, Faculty of Humanities, 2005: 134-137) mentions training in assistive listening devices, *the performance and interpretation of measures of electroacoustic characteristics of assistive listening devices are* not specifically mentioned. In this area 95% of respondents marked that they had not received training. No specific mention is made in the syllabus with regard to *description, performance, and interpretation of behavioural measures of performance with hearing aids* either. It might however be included in "hearing aid evaluation". It is likely that the actual course content cover more areas of the EHI programme as is depicted in the yearbooks' description. The yearbook supplies an overview of the content and does not supply detail information. However, if these two areas are not covered in the course content, as it seems, it might well explain the dominantly negative responses with regard to training in these areas.

From the syllabus (Regulations and Syllabi, Faculty of Humanities, 2005: 134-137) it is apparent, however, that the majority of audiologist did receive training in *paediatric hearing aid selection procedures as well as the performance and interpretation of measures of electroacoustic characteristics of hearing aids*. In order to explain the discrepancy between the actual course content, as set out in the syllabi of the educational programme, and the dominantly negative perception of undergraduate training in the indicated areas of EHI services, three possible explanations will be investigated, namely: The effectiveness of the training (Kirkpatrick, 1996: 53-75), judgemental biases (Mintzburg, Ahlstrand & Lampel, 1998: 153) and rapid technological advances in the field of EHI.

- Firstly the *training effectiveness* as possible reason for the negative responses will be investigated. The "Kirkpatrick approach to training evaluation" has become, over the past two decades, a classic model for trainers to follow, and might in this instance explain the discrepancy between the course content and

the respondents' responses (Newstrom, 1987: 147). Four criteria for the evaluation of training are defined. These are reaction, learning, behaviour and results. Reaction may be defined as how well trainees liked a particular programme, learning refers to the principles, facts and techniques that were understood and absorbed by the trainees, behaviour refers to the transfer of knowledge and skills to the working environment, and lastly the required results (Kirkpatrick, 1996: 21-26). It is thus possible that even though the respondents received training in these areas, training did not accomplish the results for which it was intended (Lerda & Cross, 1975: 210). Reactions may have been favourable and the learning objectives may have been accomplished, but the knowledge or skills learned in the programme did not transfer to the "job" (Kirkpatrick, 1996: 61). Subsequently audiologists perceived that they were not trained in these areas.

The assumption that training of South African audiologists might not have accomplished a transfer of knowledge to the working environment is in accordance with a conclusion from a national survey conducted in the USA in November 1984, assessing their practices in preparing audiologists to serve the paediatric population and their families (Oyler & Matkin, 1987: 27-33). The conclusion reads: "A substantial number of audiologists responded that they were insufficiently prepared in both assessment and habilitation of these clients, it is thus apparent that many programmes are failing to prepare their graduates adequately. Perhaps the programme directors need to appraise their programmes more realistically. Or perhaps the programme directors were reporting what they felt was available to their students in academic and practicum areas, while the audiologists were reporting the actual content of their programmes" (Oyler & Matkin, 1987: 30). To determine whether the South African audiologists' training was indeed effective falls beyond the scope of this study, but results might indicate the need for future research and training evaluation.

- The second explanation of the discrepancy of the respondents' rating of training and the undergraduate syllabi content might be that *more easily remembered recent information is favoured over earlier information*, which are downgraded or ignored (Mintzburg, Ahlstrand & Lampel, 1998: 153). This is referred to as the bias of recency (Mintzburg, Ahlstrand & Lampel, 1998: 153). This explanation might help explain why audiologists who graduated prior to 2001 rated that they were not trained in the performance of paediatric hearing aid fittings and the monitoring thereof, despite of its inclusion in the syllabi of the Department of Communication Pathology 2000 (Regulations and Syllabi, Faculty of Humanities, 2000: 180). As they have graduated five or more years ago, they are likely to have received other information regarding these topics, and this recent information is favoured over earlier information. Undergraduate training in these areas is ignored and respondents indicated that they had not been trained in these areas as a result.

- Finally advocates of evidence-based audiology argued that with the explosion of information and technology, audiologists cannot rely on the information and skills they learned in their formal undergraduate training programmes (Gravel, 2005: 18). Technology in EHI are advancing at such a pace that developments in technology often outpace research and subsequently training content (Seewald 1999: 179). It might be impossible for educational training programmes to stay current. Practicing audiologists might as a result perceive that they were not trained in certain areas of EHI as part of their undergraduate programmes.

To summarise to this point: The above discussion (part one) reflected on the respondents' perception of their undergraduate training in areas of EHI. Results were interpreted in the light of important content changes that occurred in audiology at the universities of South Africa after 2001, training effectiveness, possible biases and advances in information and technology in the field of EHI. In

part two of the discussion of the South African audiologist, the acquisition of knowledge through different sources in the areas of EHI will be discussed.

4.2.1.1.2 Part two: Audiologists' perception of the significance of different sources of knowledge in EHI

Question six revealed the perception of the significance of different training or knowledge sources of the respondents. This question reflects on training in EHI in general, pre- as well as postgraduate. The respondents evaluated undergraduate studies, postgraduate studies, postgraduate seminars, literature and knowledge sharing with colleagues in terms of their significance as a source of knowledge in EHI. By using the means procedure the knowledge sources were rated from most to least significant. Figure 4.7 summarises the results. *(All the frequencies and percentages pertaining to question six (used to calculate the mean value) are supplied in appendix three, table five. The mean values are given in appendix three, table six).*

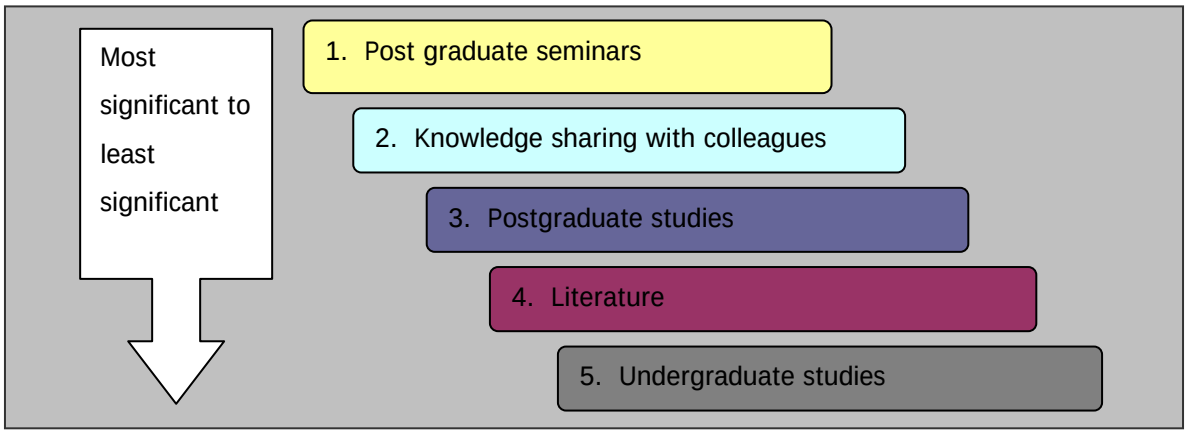


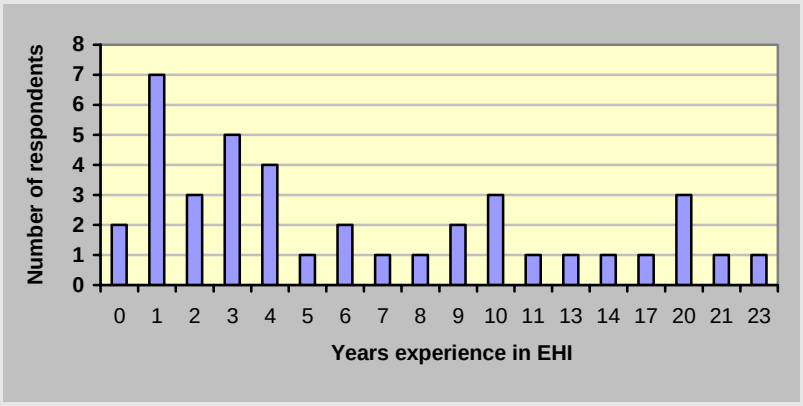
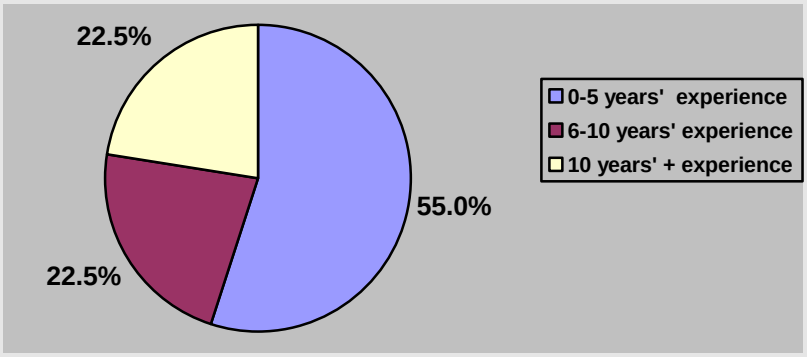
Figure 4.7 The significance of the different knowledge sources in EHI

According to figure 4.7 post graduate seminars were rated as the most significant source of knowledge by the respondents. Thereafter, rated from most to least significant as a source of knowledge in the area of EHI follows knowledge sharing with colleagues, postgraduate studies, literature and undergraduate studies. As

discussed in the previous section, respondents might be biased to favour more easily remembered recent information over earlier information, which are downgraded or ignored (Mintzburg, Ahlstrand & Lampel, 1998: 153). It is thus possible that respondents' perception of the significance of knowledge sources might be influenced by the number of years since their graduation, or otherwise stated, the years of experience they have in EHI. Subsequently a correlation between the years' experience that the respondents have and their perception of the significance of knowledge sources were investigated. Before such a correlation can be discussed the years of experience of the respondents need to be made known. The results from question seven of the questionnaire, supplying information pertaining to the years of experience of the respondents in EHI, will be discussed in the following section.

The years' experience of the respondents (results from question seven in the questionnaire) will be discussed in view of figure 4.8 and 4.9 presented in table 4.4. For statistical purposes the results were grouped together in nought to five years experience group, six to 10 years experience, and more than 10 years experience. *(The percentages and numbers of respondents and their number of years of experience are supplied in table seven of appendix three.)*

Table 4.4 Years experience of the respondents in EHI services

Discussion:	Graph demonstrating the years experience of the respondents:
From figure 4.8 it seems that most respondents have between nought and five years experience. The results are grouped together to elucidate these findings as shown in figure 4.9 of this table.	 **Figure 4.8 Respondents' years experience in EHI (n=40)**
According to figure 4.9, 55% of all the respondents have between nought and five years' experience, 22.5 % of the respondents have between six and ten years' experience and 22.5% have more than ten years' experience.	 **Figure 4.9 Respondents in the different experience groups (n=40)**

According to the information and graphs in table 4.4 it seems that more than half of the respondents have five years or less experience. The rest of the sample was equally divided between respondents with six to 10 years' experience and more than 10 years' experience.

Subsequently inferential statistics were done to investigate a possible correlation between the respondents' rating of the significance of the source of knowledge and the years' experience that they have in EHI.

Table 4.5 Years of experience versus the significance of the knowledge sources

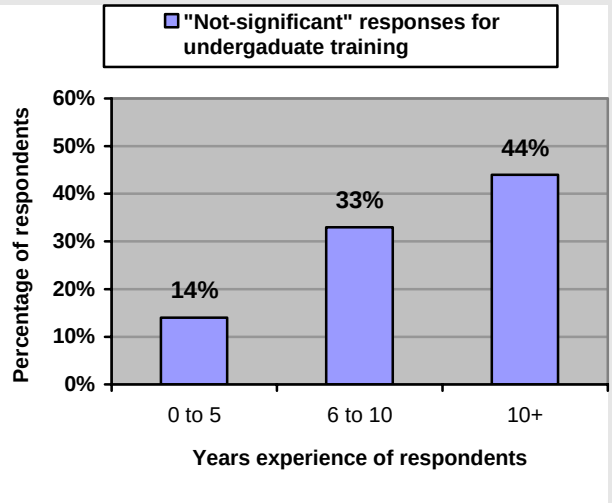
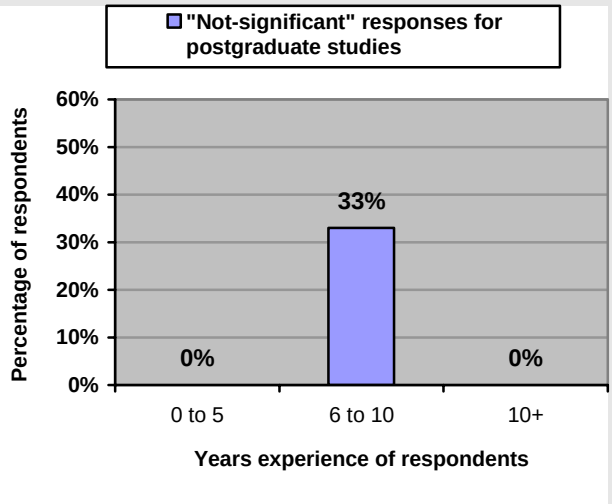
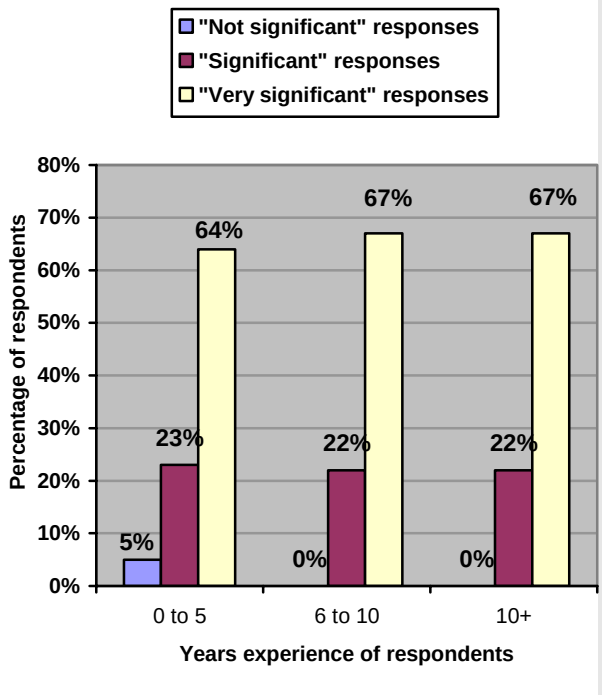
Summary of findings:	Graph / results:
• According to Fisher's exact test (Fisher, 1935) no significant statistical correlation ($p<0.1$, 90% confidence) was found between the years' experience of the respondents' and their rating of the significance of **undergraduate training**. • Results indicate an <u>increased tendency for respondents with more experience to mark undergraduate studies as "not significant"</u>, as the figure 4.10 demonstrates. • Of the respondents with nought to five years' experience, only 14% rated undergraduate studies as <u>not a significant</u> source of knowledge in the area of EHI in contrast with the rating of 33% of the respondents with six to 10 years experience who rated undergraduate studies as not-significant, and 44% of the respondents with 10 years or more experience in EHI who rated undergraduate studies as not significant. **	 **Figure 4.10 Undergraduate training as a source of knowledge in EHI (n=40)** ***(See table eight in appendix three for numbers and percentages of all ratings pertaining to the rating of undergraduate training versus years of experience).*
• According to Fisher's exact test (Fisher, 1935) a significant statistical correlation ($p= 0.07$, 90% confidence) was found between the years' experience of the respondents in EHI and their rating of the significance of **postgraduate training**. • Figure 4.11 demonstrates the nature of this correlation. All the respondents who rated <u>postgraduate studies as not significant have between six and 10 years experience</u>. Of this group 33% rated postgraduate studies as not significant. *(See table nine in appendix three for numbers and percentages of all ratings pertaining to the rating of postgraduate studies versus years of experience).*	 **Figure 4.11 Postgraduate studies as a source of knowledge in EHI (n=18)**

Table 4.5 Continued

Summary of findings:	Graph / results:
• According to Fisher's exact test (Fisher, 1935) no significant statistical correlation ($p < 0.1$, 90% confidence) was found between the years' experience of the respondents in EHI and their rating of the significance of **postgraduate seminars** as a source of knowledge in the area of EHI. • As a source of knowledge postgraduate seminars had an overwhelming positive response from respondents. • Figure 4.12 demonstrates that two thirds of all the respondents, 65%, rated postgraduate seminars as very significant. Less than 3% of all respondents rated postgraduate seminars as not significant. *(See table ten in appendix three for numbers and percentages of all ratings pertaining to the rating of postgraduate seminars versus years of experience).*	 **Figure 4.12 Postgraduate seminars as a source of knowledge in EHI (n=40)** (To demonstrate the consistency of the ratings from the different experience groups, percentages of "significant" and "very significant" ratings were also included in figure 4.12. Not applicable responses not included: n=4)
• Fisher's exact test (Fisher, 1935) revealed no significant statistical correlation ($p < 0.1$, 90% confidence) between the years' experience of the respondents in EHI and their rating of the significance of **literature** as well as **knowledge sharing with colleagues** as sources of knowledge in the area of EHI *(See table 11 and 12 in appendix three for numbers and percentages of all ratings pertaining to the rating of literature and knowledge sharing with colleagues versus years of experience).*	• All the respondents in all three experience groups rated these categories as significant. Results show that only 5% of respondents rated these categories as not significant.

Interesting findings from table 4.5 are that there seems to be an increased tendency for respondents with more experience to mark undergraduate studies as "not significant", all the respondents who rated postgraduate studies as "not significant" have between six and ten years' experience, two thirds of all the respondents rated postgraduate seminars as a very significant source of knowledge and finally literature and knowledge sharing with colleagues are rated as significant sources of knowledge in EHI by 95% of the respondents. These findings and findings summarised in figure 4.7 will be discussed and interpreted in the following bulleted section.

- The *bias of recency* as explained in section 4.2.1.1 might again explain the fact that undergraduate training received the lowest rating of significance as a source of knowledge (figure 4.7). More easily remembered recent information is favoured over earlier information, which are downgraded or ignored (Mintzburg, Ahlstrand & Lampel, 1998: 153). This assumption seems to be supported by the increased tendency for respondents to mark undergraduate studies as "not significant" with more experience (see figure 4.10 in table 4.5) as well as the overwhelming positive rating that postgraduate seminars received from all respondents (figure 4.12).

- The fact that "younger" audiologists (less experienced) rated undergraduate training different from the "older" audiologists, might also reflect on different *learning styles* as explained by Knowles (1980: 44). The assumption is made that as people mature they attach more meaning to knowledge they gain from experience, than those acquired passively. Adults become more ready to learn something when they experience a need to learn it in order to cope more satisfactorily with real-life tasks or problems (Knowles, 1980: 44). They accumulate an increasing reservoir of experience as they develop, that becomes a resource for learning for themselves and others. This fact also bears on the high ratings knowledge sharing with colleagues received.

- The fact that *information and technology advance at such a rapid pace* might influence the respondents' perception that postgraduate seminars are a more significant source of knowledge than undergraduate training. This is in line with the reality of clinical practice as explained by Feinstein and Horowitz (1997, as cited in Gravel, 2005: 17). According to them there is real probability that some of the evidence base supporting current practice will change, or be entirely refuted by evidence that will emerge in future. Because of this reality information offered by postgraduate seminars is most probably more applicable and more current than the information received in undergraduate training.

- To explain the fact that all the "not significant" ratings of postgraduate studies were from respondents with six to ten years' experience, the *nature of postgraduate training* in audiology needs to be explained. In South Africa postgraduate studies focus on specific subjects. It is thus possible that a student focusing on adult hearing evaluations, for instance, will gain no knowledge in the area of EHI by doing a postgraduate degree. To explain these findings one needs to investigate the specific subjects that were studied by these respondents. Such an investigation falls beyond the scope of this study.

To summarise; in the discussion so far the training of the audiologists was explained in terms of their perception of their undergraduate training. Areas of EHI where respondents did not receive training were identified and interpreted. Sources of knowledge in EHI were discussed in terms of their perceived significance.

4.2.1.2 The infant with hearing loss

In the following section the following characteristics and matters, regarding these infants, will be described:

1) the number of infants typically enrolled annually by the respondents (results from question nine of the questionnaire);
2) the usual age at which these infants' hearing losses were identified (results from question 10);
3) the binaural hearing aid fitting with bilateral hearing loss (results from question 19);
4) the usual time delay between:
   - the identification of the hearing loss and the availability of the EHI services (results from question 15);
   - the identification of the hearing loss and the fitting of amplification (results from question 18).

4.2.1.2.1 Number of infants enrolled in EHI programmes by South African audiologists

Question nine revealed the number of children with hearing loss (25dB or more in the 500Hz through 4000Hz region) that responding audiologists enrol in an EHI programme on average per year. For interpretation purposes respondents were divided into four groups: Audiologists who enrol on average between nought and five, six and 10, 11 and 20 and 20 or more infants with hearing loss in an EHI programme per year. These results will be discussed in view of figure 4.13.

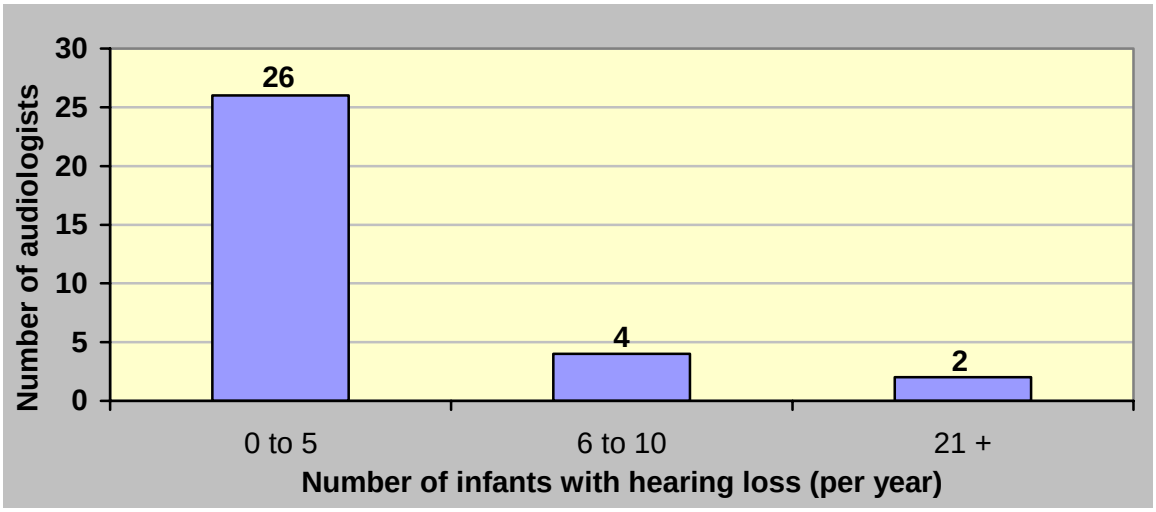


Figure 4.13 Number of infants with hearing loss enrolled in EHI programmes (n=32)

The results revealed that on average respondents enrol 230 children per year in EHI programmes. From figure 4.13 it is apparent that the majority of audiologists (26 of 32) enrol between nought and five infants with hearing loss per year. The reader is reminded that this is not a representative sample of all infants born with hearing loss in South Africa as only one questionnaire per institution was sent (refer section 3.5.2).

As discussed in the previous paragraph, it is clear that the majority of audiologists enrol very few infants with hearing loss per year. To view the numbers in context though, it would be necessary to compare the number of infants with hearing loss that is served by respondents compared to the number of adults in their practice/ institution. It seems reasonable though to assume that infants in EHI programmes are a small part of the case load of these audiologists, as a private practice, clinic or institution would not be able to validate its existence for five or less clients per annum. Consequently enrolling less than five infants with hearing loss per year will negatively influence the experience gained in this area.

4.2.1.2.2 Average age of the infant at identification of the hearing loss

Question 10 revealed the average age of the infants at the time of diagnosis of the hearing loss. The means procedure was used to estimate an average number of infants diagnosed before six months old, between six and 12 months, between 12 and 24 months and between 24 and 36 months of age. Figure 4.14 shows these averages.

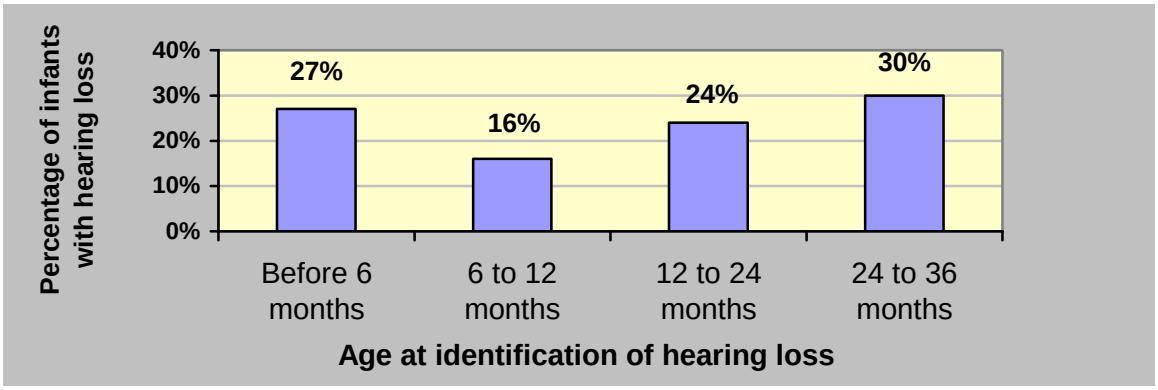


Figure 4.14 Average age at identification of hearing loss

Figure 4.14 demonstrates that most infants with hearing loss (30%) are diagnosed between 24 and 36 months of age. Only 27% of infants are diagnosed before six months of age, 16% between six and 12 months and 24% between 12 and 24 months.

According to the results only 27% of infants are diagnosed with hearing loss before six months of age. Seen in the light of the fact that infants with permanent hearing loss who start receiving intervention before six months of age maintain language development commensurate with their cognitive abilities through the age of five years (Yoshinaga-Itano & Gravel, 2001: 63), these figures are concerning.

However, when interpreting these results it is important to remember that surveys of EHI programmes cannot be used as an index of the average age at identification of hearing loss. While surveys provide valuable information for the profession, they are not designed as an accurate measure of the average age of diagnosis of hearing loss (Yoshinaga-Itano, 2004: 460). For this survey audiologists were asked to indicate the estimated percentages of infants in their EHI programmes diagnosed in the four age groups specified. No audiogram or other data was submitted to verify the information provided. *These percentages should thus not be interpreted as verified evidence*, but should rather serve as an indication of what respondents perceived as the average age of diagnosis of hearing loss of infants in their EHI programme. Further research is needed to verify the average age of diagnosis of hearing loss in infants in South Africa.

4.2.1.2.3 Binaural hearing aid fitting

Figure 4.15 demonstrates the percentage of responding audiologists that fit infants with bilateral hearing loss with binaural hearing aids (results obtained from question 19 and 20).

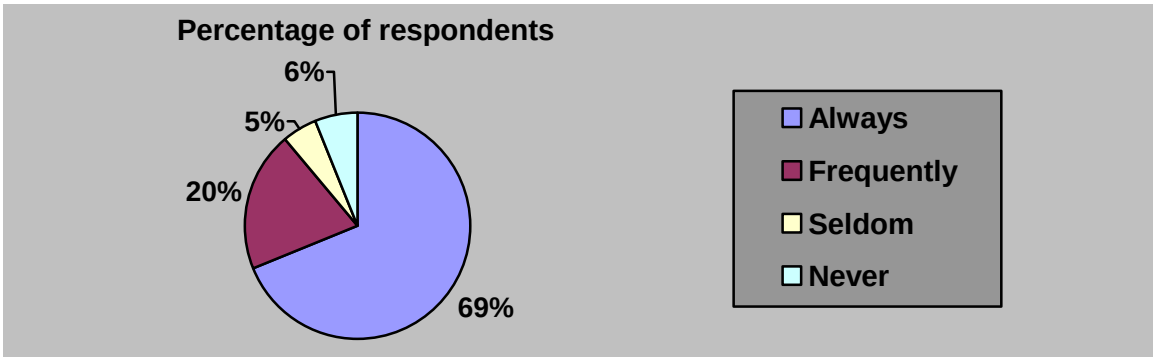


Figure 4.15 Binaural hearing aid fitting (n=35)

According to figure 4.15 more than two thirds of respondents (69%) always fit infants with bilateral hearing loss (and no contra indication) with binaural hearing aids. However, a combined 31% of respondents indicated that infants with bilateral hearing loss are not fitted routinely with hearing aids binaurally.

These results are concerning when viewed in the light of the importance of binaural hearing in abilities such as the localisation of sound, understanding speech in noise and suppressing echoes and the deprivational effect of a monaural hearing aid fitting in the presence of bilateral hearing loss (Kuk, 2002: 505, Litovsky, 2001: 25, Boothroyd, 1993: 336).

These results will only be fully understood in the context of the unique difficulties that South African audiologists experience when fitting infants with hearing loss with hearing aids. These factors will be discussed in section 4.2.5 where the unique factors that influence the service delivery to South African infants with hearing loss will be discussed under the category "*Mother Nature". F*actors such as the cost of two hearing aids as well as the way disability is viewed by the society might influence the provision of binaural hearing aids to infants with bilateral hearing loss.

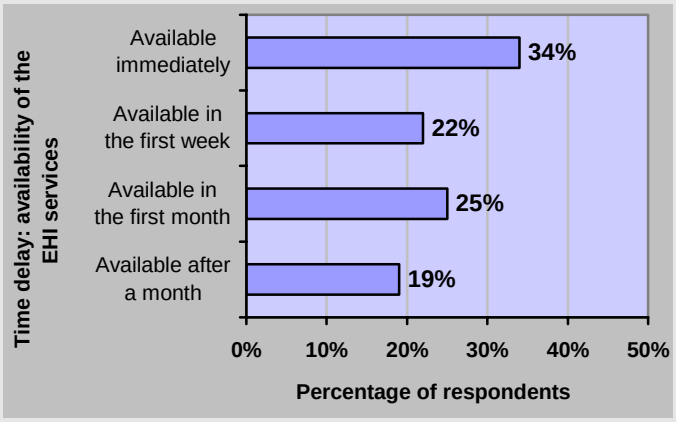
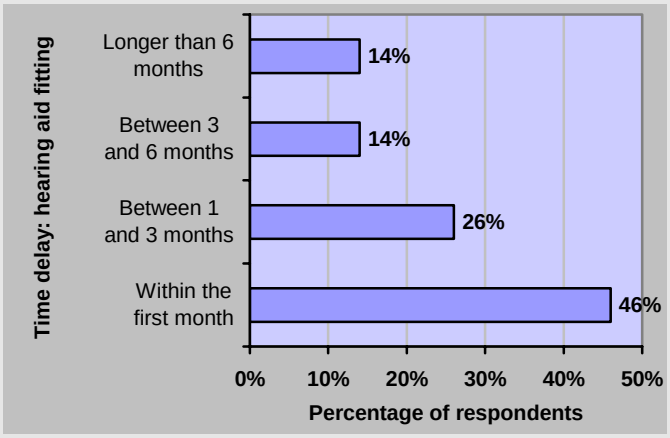
4.2.1.2.4 The usual time delay between:

- *The identification of the hearing loss and the availability of the EHI services*
- *The identification of the hearing loss and the fitting of amplification*

A time delay between the confirmation of hearing loss and the availability of EHI services and a time delay between confirmation of hearing loss and the fitting of amplification for infants with hearing loss are important factors influencing the nature of the EHI programme. Results revealing information about these time delays in the service rendered to infants with hearing loss by respondents were

attained from questions 15 and 18 of the questionnaire. Results will be discussed and depicted in figure 4.16 and figure 4.17, summarised in table 4.6.

Table 4.6 Time delays influencing the respondents' EHI programmes

Summary of results:	Graph:
• Thirty four per cent of respondents indicated that the EHI services to the infant with hearing loss and his family are available immediately. • Another 22% indicated that the services are available in the first week. • Twenty five per cent indicated that the services are available in the first month. • Nineteen per cent indicated that the services are available after a month.	 **Figure 4.16 Time delay: Availability of the EHI services (n=32)**
o Fourty six per cent of respondents usually fit the infant with amplification within the first month after confirmation of hearing loss. o A further 26% of respondents indicated that they fitted infants between one and three months after confirmation of hearing loss. o Fourteen per cent fitted infants with amplification between three and six months. o Fourteen per cent of respondents fit amplification more than six months after confirmation of hearing loss	 **Figure 4.17 Time delay: Hearing aid fitting (n=35)**

From the results demonstrated in figure 4.16 it seems that only 34% of respondents indicated that the EHI support services are available to the infants

with hearing loss and his/ her family immediately after confirmation of the hearing loss. Early identification alone is unlikely to result in improved outcomes if it is not followed by early intervention (Yoshinaga-Itano et al, 1998: 170). The age of identification is important as a younger age of identification might lead to a younger age at enrolment into an EHI programme and a younger age at fitting of amplification. This is dependent however on the *availability* of these services and the subsequent fitting of amplification for infants with hearing loss. The EHI programme involves family support and supplying information regarding hearing loss and the range of available communication and intervention options (JCIH, 1994: 38-41). This component of the EHI programme forms an important part of the EHI programme and it seems logical that it should be available immediately. It is possible, however, that the results might be influenced by the differing perceptions of the components that form part of the EHI programme. If, for instance, the selection of amplification is regarded as the first component of the EHI programme, it seems reasonable that it is only made available after the initial visit. It is important that the support of the parents as well as the sharing of information about intervention options, support groups, etc, should be regarded as important components of the EHI programme and should be available immediately. The components that are typically regarded as part of the EHI programme as indicated by the respondents, will be discussed in section 4.2.2, and might explicate these findings.

Results from question 18, shown in figure 4.17, indicate that less than 50% of respondents fit children with amplification within the first month after confirmation of the hearing loss. Several barriers to the timely fitting of amplification may exist for South African infants. These may include socio-economic barriers such as the lack of access to centres where EHI services are provided due to inadequate transport, the lack of parental involvement that may be influenced by the fact that their participation is not facilitated and financial constraints hindering the timely provision of amplification devices (Department of Education, 1997: 18). The

unique difficulties that South African audiologists experience when fitting infants with hearing loss with hearing aids will be discussed in section 4.2.5. While there might be justifiable reasons for the delays in fitting hearing aids to newly diagnosed infants, the results are still cause for concern.

In a study described by Bamford (2000: 153) approximately 35% of parents reported that their infants had not been fitted with hearing aids within the first month after confirmation of hearing loss. Results from the current study, indicating that 54% of responding South African audiologists do not typically fit infants with hearing loss with hearing aids within one month after confirmation of hearing loss, seem poorer and might be explained in the light of the fact that South Africa is a developing country and the UK part of the developed world (Bamford, 2000: 151). The fact that the UK questionnaire surveyed parents and this research study surveyed the service provider, the South African audiologist, might also explain the difference in results. It is possible that South African parents' perception of the time delay between the fitting of hearing aids to newly diagnosed infants might differ from that of responding audiologists' perception. There is evidence of important perceptual differences between parents and professionals during the early stages of identification and intervention (Roush, 2000: 159). To survey South African parents of infants with hearing loss in this regard might serve as an important recommendation for future research and might elucidate perceptual differences between South African audiologists and parents concerning service delivery to infants with hearing loss in South Africa.

4.2.1.3 The parents/caregivers of infants with hearing loss

Parents or caregivers of the infant with hearing loss are the next group discussed in the category "man". Results obtained through the questionnaire will be discussed to describe the participation of parents or caregivers of infants with

hearing loss in the EHI programmes in South Africa with regard to the following points:

- the perceived involvement of parents in the EHI programme (results from question 12);
- the nature of the information supplied and the documentation thereof to parents by respondents (questions 13 and 14).

4.2.1.3.1 Parental involvement in the EHI programme

Results of question 12 revealed the level of involvement of the parents in the EHI programme of the responding audiologists. Figure 4.18 demonstrates the level of involvement of the parents in deciding on the modes of communication and the support and intervention of the infant with hearing loss, their role in monitoring the effectiveness of the EHI programme, as well as their role in self-advocacy, which refers to active support and pleading for the infant.

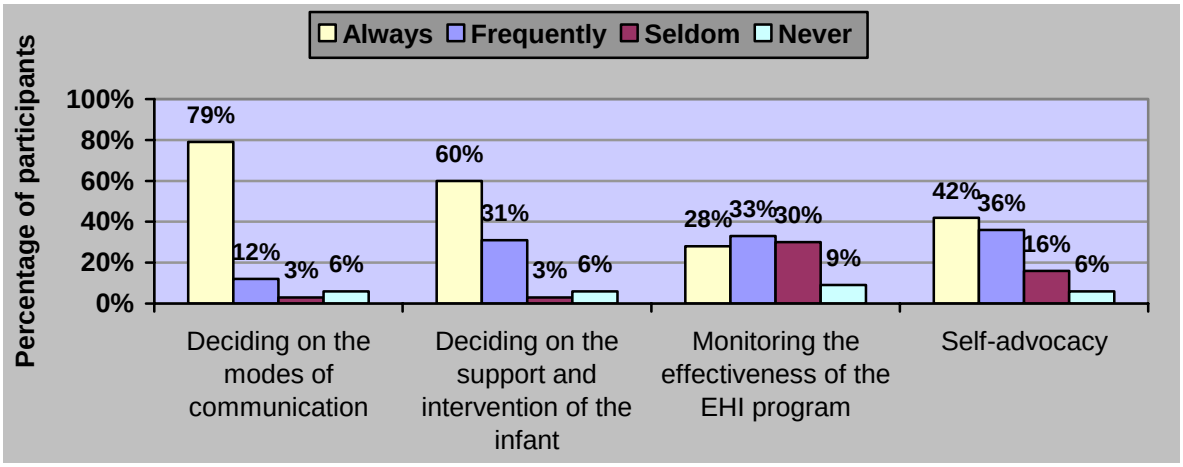


Figure 4.18 Parental involvement in specific areas of the EHI programme (n=34)

According to figure 4.18 the vast majority of audiologists (n=27, 79%) indicated that parents are always involved in deciding on the modes of communication of the infant with hearing loss. When deciding on the support and intervention of the infant 60% of audiologists indicated that parents are always involved. It seems that parental involvement in the monitoring of the effectiveness of the EHI programme is rated the lowest by audiologists. Only 28% of respondents indicated that parents are always involved in the evaluation process. With regard to self-advocacy (active support and pleading for the infant) only 42% of respondents indicated that parents are always involved.

Fundamental to family-centred early intervention is the fact that parents are equal partners and decision-makers in the EHI programme (Bamford, 2000). In two of the evaluated areas, namely deciding on the communication mode and the support and intervention services for the infant with hearing loss, there seemed to be agreement among respondents that parents are always or frequently involved.

Only 42% of respondents indicated that parents are involved in self-advocacy all the time. The term self-advocacy refers to active support and pleading for the infant with hearing loss (Longman Family Dictionary, 1984: 10). Sharply differentiated ratings within a group often are a product of unclear terminology (Newstrom, 1987: 194). A definition of self-advocacy was included in the questionnaire, yet it is not a term widely used by audiologists. It is possible that this item in the questionnaire might have been confusing to audiologists and might be the reason for a less definite rating. Another explanation might be found in the results of a study by Roush (2000: 160) explaining that when there is a discrepancy between parent and professional priorities there may be reluctance on the part of the audiologist to defer to family priorities. It is possible that South African audiologists might experience the same reluctance in giving ultimate authority to the parents and hence not involving them as advocates on behalf of their children. The active involvement of parents in the life of the infant with

hearing loss is central to the effectiveness of the EHI programme. Where the critical role of the parent in facilitating development of communication and other abilities in the infant with hearing loss is not recognised or where their participation is not facilitated or encouraged, effective learning is threatened or hindered (Department of Education, 1997: 35).

With regard to parental involvement in the monitoring of the effectives of the EHI programme, respondents seemed to be of different opinions. An explanation of this relatively negative rating of parental involvement in the monitoring of programme effectiveness, compared to the overwhelmingly positive rating of some other areas of parental involvement, might be a lack of guidelines or benchmarks to evaluate effectiveness of the EHI programme (JCIH, 2000: 19). In section 4.2.2.3 the monitoring of the programme effectiveness will be discussed and will further elucidate these findings. If responding audiologists have no system in place to evaluate the effectiveness of the EHI programme, parental involvement is jeopardised. This emphasises the importance of a South African protocol for EHI and support services that may be used to guide service delivery.

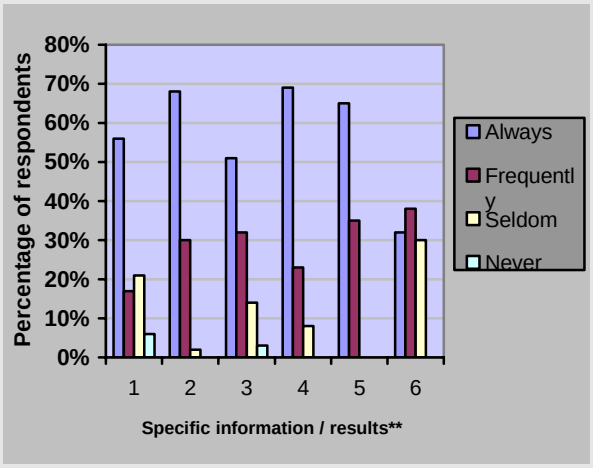
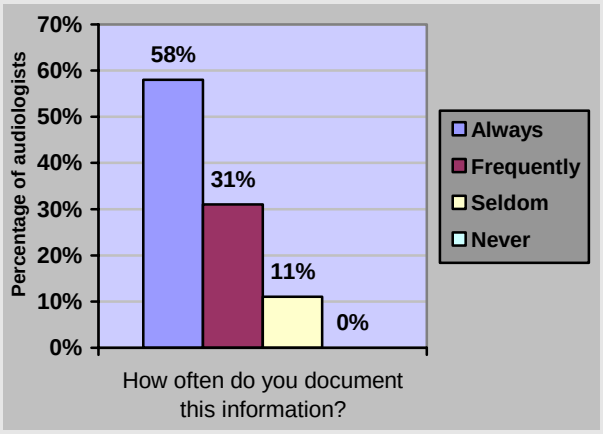
4.2.1.3.2 Sharing information with parents

Results from questions 13 and 14 regarding the sharing of information with the parents of the infant with hearing loss is summarised in table 4.7 and illustrated with figure 4.19 and figure 4.20.

According to the information as demonstrated by figures 4.19 it seems that information about support groups are less frequently supplied than any other information during the EHI service delivery. This finding correlates with the findings from a survey conducted by Roush (2000: 162) where parents expressed a desire for more contact with other parents and information about support

groups. According to the results demonstrated in figure 4.20 most respondents indicated that they supply documented information regarding all components of the intervention plan. In the questionnaire no distinction was made in respect of the documentation of the different kinds of information. It is thus possible that some of the information supplied is documented (e.g. copies of the audiogram) and others not (e.g. written management plans). In a study by Bamford (2000: 154) audiologists in the UK were asked whether thorough documented information was supplied during the EHI programme. Respondents were asked about the frequency with which they supply parents with copies of audiograms, written management plans, and information about the NDCS branch and address. Obtained results were very different for the different kinds of information. Seventy per cent of the audiologists in the UK study supplied the information about the NDCS branch, but a mere 10% routinely gave copies of the audiograms and written management plans (Bamford, 2000: 155). According to the results of the current study, as demonstrated by figure 4.20, it seems that 58% of the respondents routinely document information. It is likely that fewer respondents routinely document information and that the results might have been different if the different areas and types of information were specified (as in figure 4.19 in table 4.7).

Table 4.7 Sharing and documenting of information and results

Discussion of results:	Graph:
• According to figure 4.19 most respondents (50% or more) indicated that they always supply parents with copies of the audiogram, other audiologic assessments with full explanation, information about the full range of resources in EHI, information about the educational programmes or options and information about different communication mode. • Only 32% of respondents supply information about support groups all the time. Thirty eight per cent however indicated that they frequently supply parents with information about support groups. • Less than a third of respondents (less than 33%) indicated that they never or seldom supply copies of the audiogram, other audiologic assessments with full explanation, information about the full range of resources in EHI, information about the educational programmes or options, different communication mode and support groups.	 **Figure 4.19 Provision of information (n=37)**
• According to figure 4.20, 58% of audiologists always document given information, 31% frequently document it, 11% seldom do and nobody indicated that they never document given information.	 **Figure 4.20 Documenting the information (n=36)**

**Specific information / results:	
1	Copies of the audiogram
2	Other audiologic assessments with full explanation
3	Information about the full range of resources in EHI
4	Information about the educational programmes or options
5	Information about different communication modes
6	Information about support groups

4.2.1.4 Team members

The multidisciplinary team responsible for the EHI and support services to the South African infant with hearing loss were dealt with in question 11 of the questionnaire. Figure 4.21 illustrates the specific team members usually involved in the EHI programme.

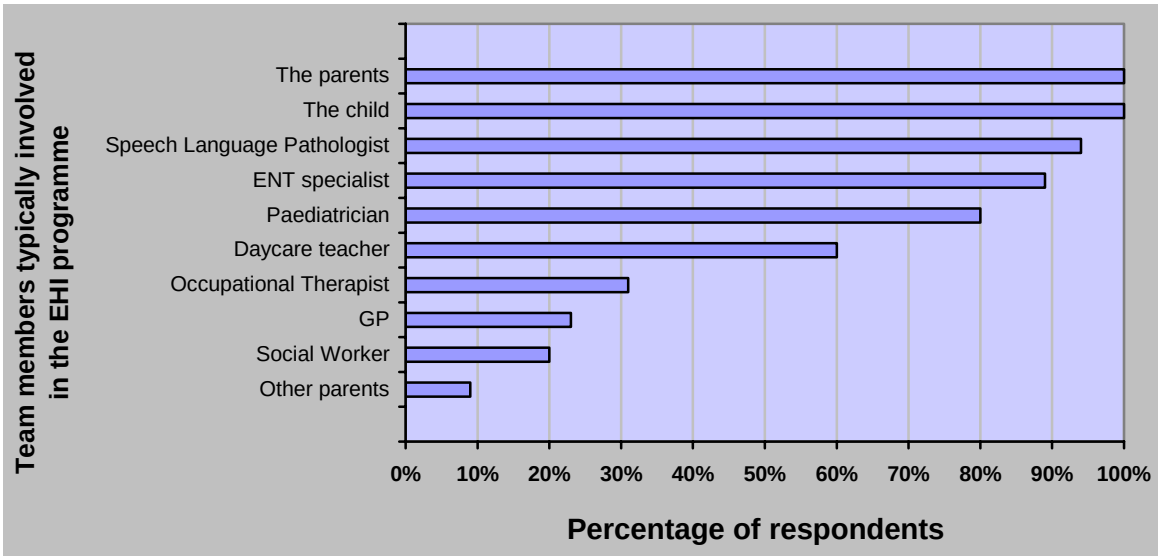


Figure 4.21 Team members in the EHI programme (n=35)

According to figure 4.21 the large majority of the respondents (more than 80%) indicated that the infant with hearing loss, the infant's parents, the paediatrician, the speech language pathologist and the ear, nose and throat specialist are usually part of the multidisciplinary team involved in the EHI programme. Sixty per cent of the respondents indicated that the infant's day-care teacher or educator is usually involved in the multidisciplinary team. Less than 40% of respondents indicated that they involve the social worker, the general practitioner, occupational therapist or other parents in the multidisciplinary team.

According to this information there seems to be agreement among the respondents with regard to the team members usually involved in the multidisciplinary team in the EHI programme. The success of the EHI programme depends on the professionals working in partnership with families in a well-coordinated, multidisciplinary team (Moeller, 2000 in JCIH, 2000: 12). Only 9% of the respondents usually involve other parents as part of the team. In a parent survey done by Roush (2001: 162) one of the most frequently cited issues was a desire for more contact with other parents. According to the findings of the current study, respondents rarely involve other parents as part of the multidisciplinary team and parents might subsequently have less contact with other parents. In section 4.2.1.3, figure 4.19, results about specific information given to parents were discussed and indicate that information about the available support groups are seldom supplied to parents of infants with hearing loss. In conjunction with other parents not being part of the multidisciplinary team, this might create a need for parents to have more contact with other parents as found by Roush (2000: 126).

The above discussion of the team members, who usually form part of the multidisciplinary team in the EHI programme, concludes the discussion of the results describing the persons involved in the EHI programme. They were discussed as part of the category “man”.

4.2.2 Method

“Method” refers to the systematic procedures or protocols used during all the components of the EHI services (JCIH, 2000: 13). Figure 4.22 revealed the kind of protocol used during EHI services to guide these services.

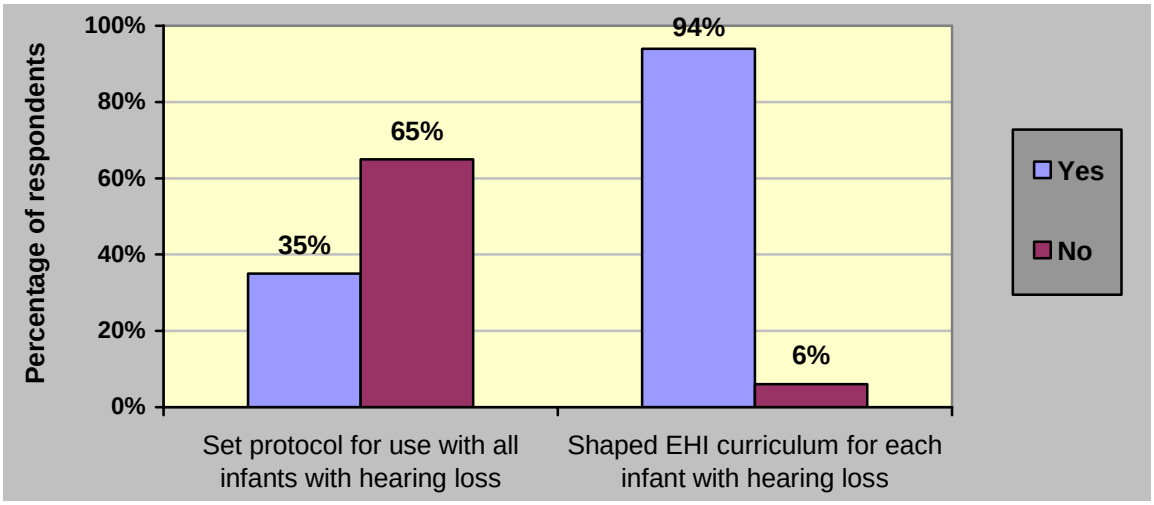


Figure 4.22 Protocol used for EHI services (n=34)

Figure 4.22 revealed the results acquired from question 16 of the questionnaire. The first part of the question asked whether the participant used a set protocol during EHI services for all children with hearing loss (including communication mode). 35% of respondents indicated that they do and 65% of respondents indicated that they do not. The second part of the question asked whether respondents shaped the EHI curriculum to the infant and family profile. The vast majority of audiologists revealed that they do (94%) and only 6% indicated that they do not.

These results revealed an inconsistency that can only be explained by a critical analysis of the question asked. Question 16 consists of two parts. Part one asked about the use of a set protocol for all infants during EHI services (including communication mode). It was assumed that respondents would choose either a set protocol or a shaped curriculum. In this question the use of a *set protocol* was thus opposed to the use of an individualised family-centred EHI programme. A protocol is defined as a code of correct conduct (Longman Family Dictionary, 1982: 548), can be used to guide service delivery and should be based on the

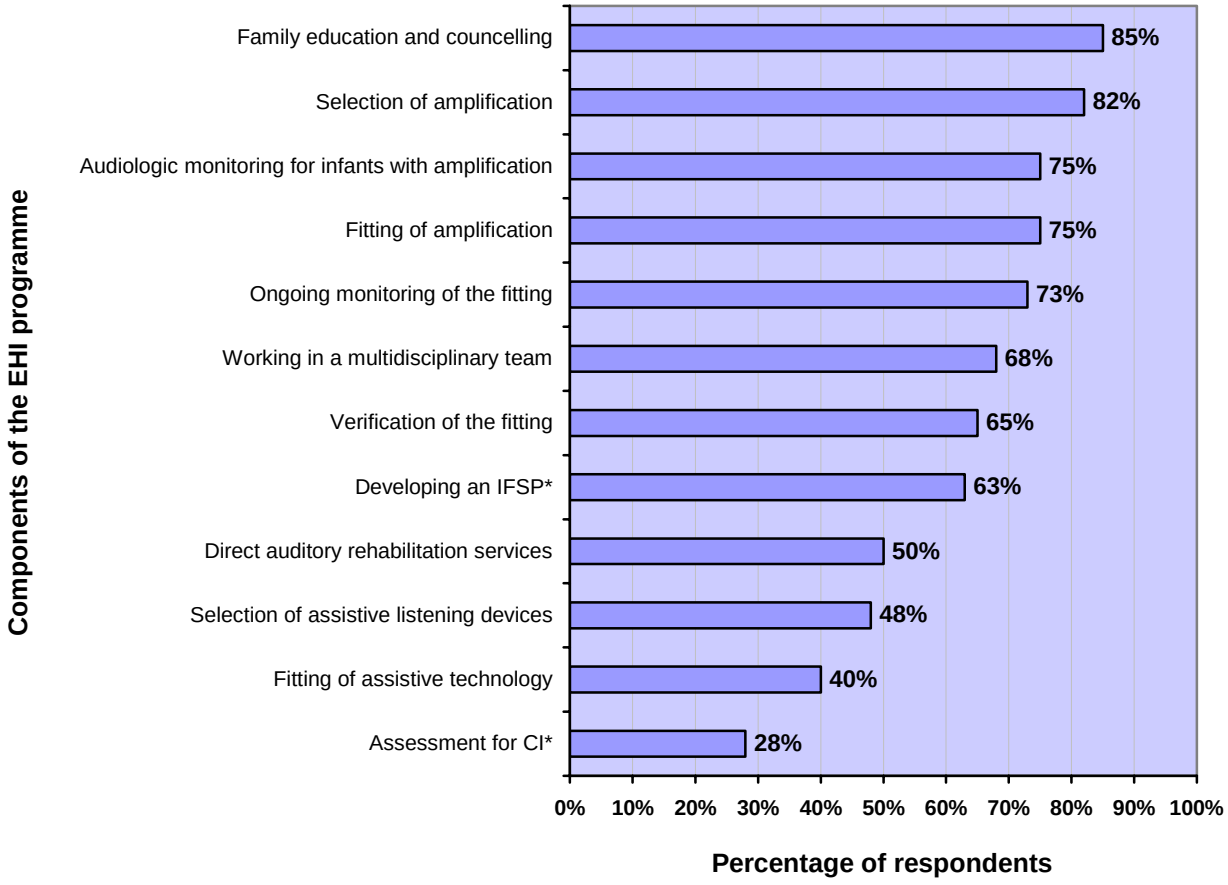
available evidence base (Bamford, 2000: 151). The use of a protocol when delivering EHI services is recommended, given that the protocol is shaped to the individualised family needs. The ambiguity that this question creates possibly influenced the respondents' responses (Mouton, 2001: 103). Thirty five per cent of the respondents indicated that they use a set protocol for all infants with hearing loss. This result does not correlate with the 94% of respondents who indicated that they shape the EHI curriculum to suit family needs (as these answers were opposed to each other the total should add up to 100%).

The high degree of agreement within the group of respondents concerning the use of an individualised family-centred programme indicates the reliability of this response (Newstrom, 1987: 193). For the interpretation of these results the latter part of the question (that is the use of an individually shaped curriculum to suit the infant and family's profile) will be interpreted as reliable. It therefore seems that the vast majority of responding audiologists do shape the EH curriculum to suit the infant with hearing loss and his/ her family's needs. Protocols or systematic procedures should be sensitive to the specific desires of families for the intervention of their infant with hearing loss as well as the social-emotional issues surrounding the identification of their child's hearing loss (Seewald, 2000: 211).

Consistency within the individualised family-centred EHI programme should be maximised with regard to the components of the EHI programme, the follow-up visits during rendering of EHI services and finally the monitoring of the quality of all components of the EHI programme. Results will be discussed according to these three aspects.

4.2.2.1 The components of the EHI programme

Question eight revealed the specific components that usually form part of the EHI programme in which the South African audiologists are involved. Figure 4.22 demonstrates the percentage of responding audiologists who indicated the specific components that usually form part of the EHI programme in which they are involved.



* IFSP= Individualised Family Service Plan, CI= Cochlear Implant

Figure 4.23 Components of the EHI programme (n=40)

According to figure 4.23 *more than 60%* of the respondents included the following components as part of their EHI programme:

- family education and counselling;

- selection of amplification;
- ongoing audiologic monitoring for infants with amplification;
- fitting of amplification;
- ongoing monitoring of the fitting;
- working in a multidisciplinary team;
- verification of the fitting;
- developing an individualised family service plan (incorporating the family preference for outcome).

To elucidate these findings questions were asked about the monitoring of the hearing aid fitting (typically included by respondents as part of the EHI programme) as well as the monitoring of audiologic findings. As the monitoring of the audiologic findings as well as the monitoring of the hearing aid fitting typically form part of the follow-up visits, the monitoring of these findings will be discussed under section 4.2.2.2.

The respondents seemed to be split in their inclusion of the *provision of direct auditory rehabilitation services* (e.g. auditory and speech training). Fifty per cent of respondents revealed that they provide direct auditory rehabilitation services (e.g. auditory and speech training). Question 34 of the questionnaire revealed whether responding audiologists provided, referred for or neither provided nor referred for auditory rehabilitative services to infants with hearing loss. It will be discussed as part of this section as it might aid interpretation of these results. Figure 4.24 summarises the results of question 34 of the questionnaire.

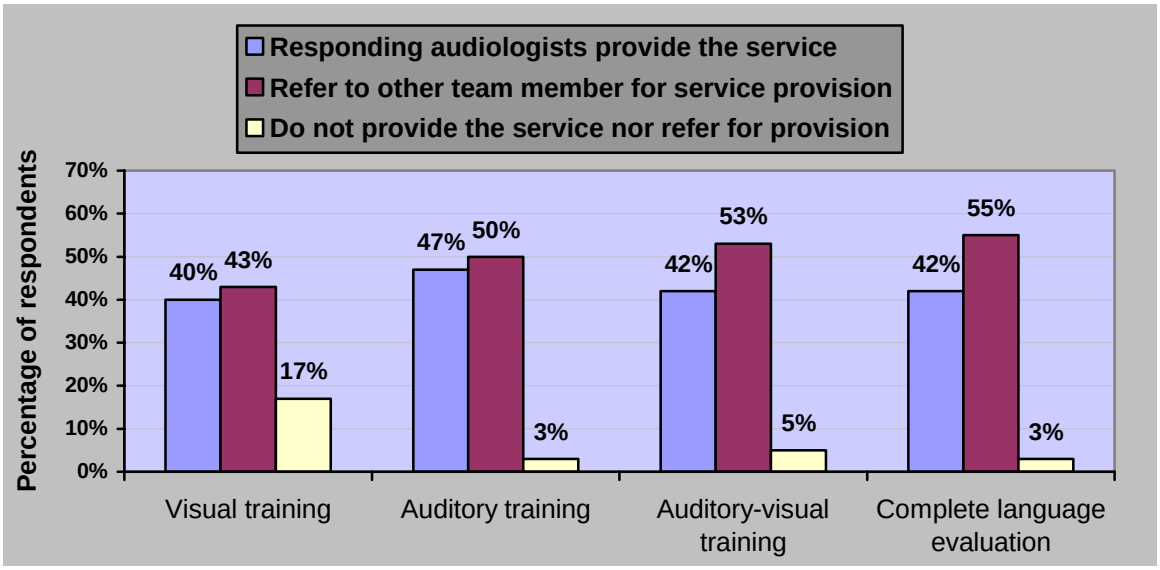


Figure 4.24 Communication evaluation and specific rehabilitation services (n=36)

From figure 4.24 it seems that results are divided between respondents who provide the rehabilitation service (visual training, auditory training, auditory-visual training and a complete language evaluation) and respondents who refer to other team members for the provision of these services. Very few respondents (three to 17%) indicated that they do not provide nor refer for the provision of these services. These results could serve to explain why only 50% of respondents indicated that the provision of auditory rehabilitative services form part of the EHI programme in which they participate. In the light of figure 4.23 it could be assumed that most of the other 50% of audiologists refer to team members for the provision of these services. No statistically significant correlation (using Fisher's exact test) was found between the years' experience of the respondents and the inclusion of rehabilitation services provided as part of the EHI programme.

These findings are probably a reflection of the provision of these services in the field of audiology. Johnson and Danhauer (2002: 204) states that many audiologists do not provide "direct-service therapy" to children with hearing loss.

This is not in accordance with the scope of practice of audiology as defined by the American Speech-Language-Hearing Association (ASHA, 2004: 1-9). This policy document states that the practice of audiology includes: "Provision of comprehensive audiologic rehabilitation services, including management procedures for speech and language habilitation and/ or rehabilitation for persons with hearing loss or other auditory dysfunction, including but not exclusive to speechreading, auditory training, communication strategies, manual communication and counselling for psychosocial adjustments for persons with eharing loss and other auditory dysfunction and their families/ caregivers" (ASHA, 2004: 5). No reasons were supplied by respondents of this study why they refer for these services and not provide them directly. Johnson and Danhauer (2002: 204) remind that although many audiologists do not provide these services directly, they should be able to inform parents when the treatments that they are involved in are fad. Four characteristics are named, they are; treatment that makes claims without empirical evidence, popularity prior to demonstrated effectiveness, treatment approaches where most articles appear in non-refereed publications and finally treatments that claim universal success without alternatives (Johnson and Danhauer, 2002: 204).

Finally figure 4.23 demonstrates that *less than 50%* of respondents included the following components as part of their EHI service:

- selection of assistive technology;
- fitting of assistive technology;
- participation in the assessment of candidacy for cochlear implantation.

Very few respondents (28%) included participation in the assessment for candidacy for cochlear implantation as part of their EHI programme. This is possibly due to the fact that there are only a few cochlear implantation teams in South Africa. According to L. Nauta (personal communication, August, 2005)

additional licensing is needed to provide services as an audiologist in a cochlear implantation team since January 2005.

With regard to the fitting of FM technology, Gabbard (2005: 157) noted that many parents are overwhelmed by the unexpected demands of hearing aid use and often are better prepared to accept and appreciate the challenges and benefits of FM technology a few months later. It is possible that the same might be true of practicing audiologists. As audiologists gain more experience with the fitting of hearing aids they might be more prepared to include the use of FM technology for infants with hearing loss. In order to investigate this possibility, inferential statistics were done to investigate a possible relationship between the years' experience of the respondents and the exclusion of FM system selection and verification as part of the EHI programme. Fisher's exact test (Fisher, 1935) was done to investigate a possible correlation. A correlation (p 0.018, 95% confidence) was indeed found between the inclusion of the *selection of assistive technology and the years' experience of the respondents*, and will be depicted in figure 4.25.

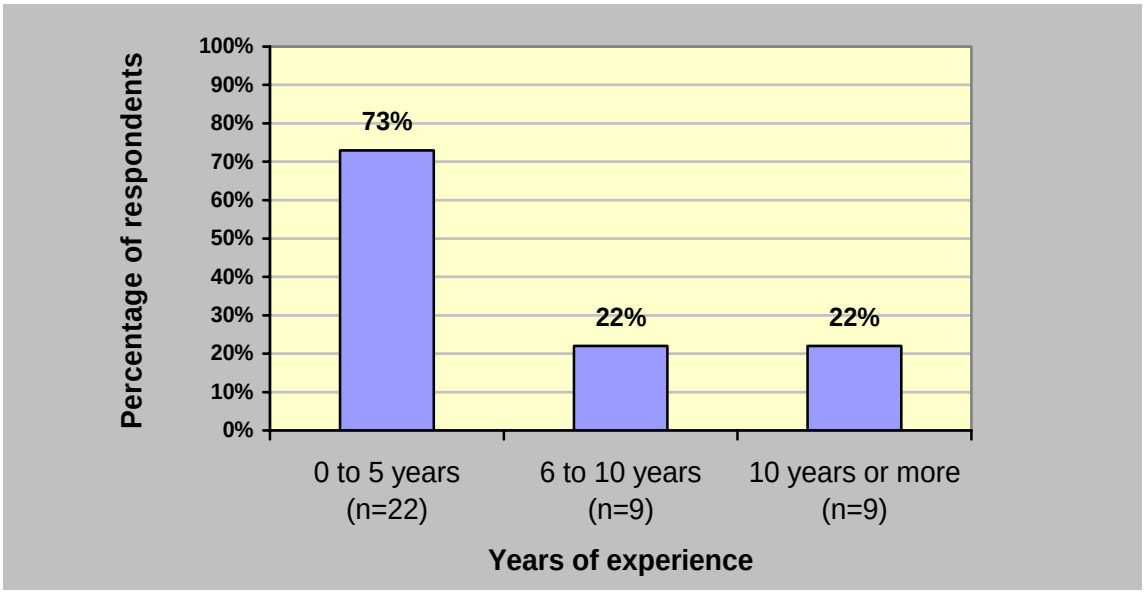


Figure 4.25 Selection of assistive technology as part of the EHI programme (n=40)

According to figure 4.25 more than two thirds of the naught to five years' experience group indicated that they do not usually include the selection of assistive technology as part of the EHI programme they are involved in.

These results reveal that most responding South African audiologists with more experience do include it as part of the EHI programme. In section 4.2.1.1, results revealed that 95% of respondents indicated that they did not receive undergraduate training in the electroacoustic fitting and verification of assistive listening devices. Audiologists with little experience in the fitting of assistive devices as well as a possible lack of knowledge in the area might lack the confidence to select and fit assistive devices for infants with hearing loss.

4.2.2.2 Follow-up visits with infants with hearing loss and their families

Results revealed the components usually included by respondents in the follow-up visits with infants with hearing loss (results from question 33). As part of follow-up visits the monitoring of the audiologic findings and the monitoring of the hearing aid fitting will also be discussed (results from questions 31 and 32).

4.2.2.2.1 Components included in the follow-up visits

Figure 4.26 summarises results from question 33, regarding the components that are usually included in the follow-up visits with infants fitted with amplification.

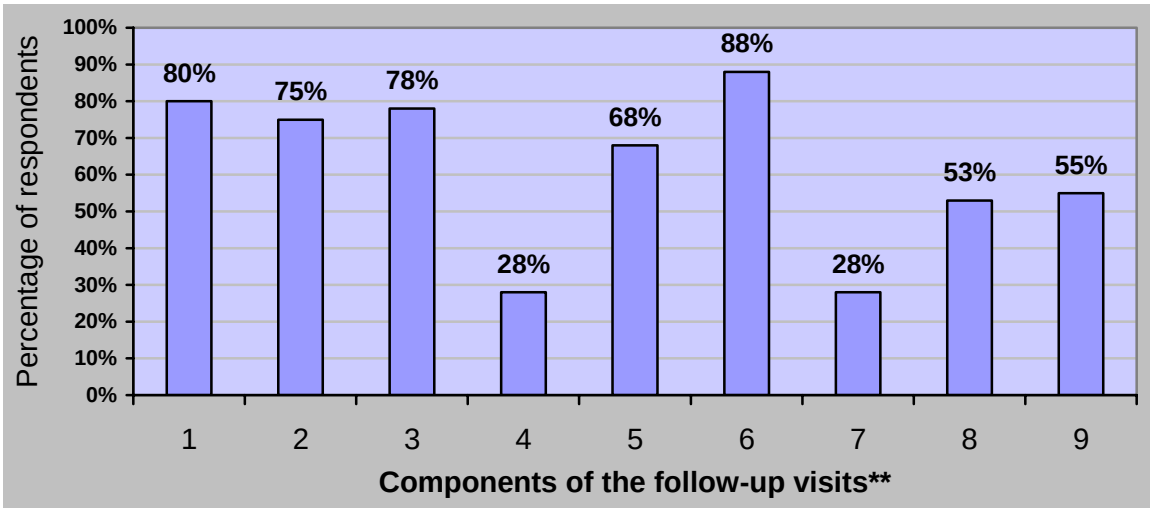


Figure 4.26 Follow-up visits (n=40)

Components of the follow-up visits:	
1	Behavioural audiometric evaluations
2	Assessment of communication abilities, needs and demands
3	Adjustments of the amplification system based on updated audiometric information and communication demands
4	Periodic electroacoustic evaluations
5	Listening checks
6	Ear mould fit checks
7	Periodic probe-microphone measurements
8	Periodic functional measures to document development of auditory skills
9	Long-term follow-up (through interdisciplinary evaluations) including academic progress

According to figure 4.26 the majority of respondents (more than two thirds) indicated that they include behavioural audiometric testing, assessment of communication abilities, needs and demands, adjustment of the amplification system based on updated audiometric information and communication demands, listening checks and ear mould fit checks. Approximately half of the respondents indicated that they include periodic functional measures to document development of auditory skills (53%) and long-term follow-up (through interdisciplinary

evaluations) including academic process (55%). Only 28% of respondents include electroacoustic evaluations and probe-microphone measurements.

There seemed to be an agreement (more than 60% of the respondents) that behavioural audiometric testing, assessment of communication abilities, needs and demands, adjustment of the amplification system based on updated audiometric information and communication demands, listening checks and ear mould fit checks are included in their follow-up visits with infants fitted with amplification. These results might be interpreted as reliable (Newstrom, 1987: 193).

Less agreement was found for the inclusion of long-term follow-up (through interdisciplinary evaluations) as part of the follow-up visit. This finding is in contrast with the results described in section 4.2.1.4 where responding audiologists indicated that they usually work in a multidisciplinary team. Perhaps this finding reflects on the nature of the teamwork and the nature of the audiologists' involvement in the team. Future research might elucidate the interactive nature of the multidisciplinary team. It might also reflect on the long-term relationship or absence thereof, of the audiologist and the infant with hearing loss. Another possible explanation for this finding might be that families who live in underserved areas might have less access to services (JCIH, 2000: 18) and it might be difficult to bring about long-term follow-up of the infant with hearing loss.

Finally pertaining to the inclusion of functional measures as part of the follow-up visit, results indicate that almost half of the respondents did not include functional measures in the follow-up visits with infants fitted with hearing aids. Less than two thirds of responding audiologists included probe-microphone measurements or electroacoustic measurement as part of the follow-up visit. The nature of these services will be discussed in section 4.2.3.

4.2.2.2.2 Monitoring of the audiologic findings and hearing aid fitting

The efficacy of the hearing aid fitting is predicated on the validity of the audiologic assessment (The Pediatric Working Group, 1996: 54). Due to the importance of the validity of the audiometric data for the fitting of amplification, results regarding the audiologic monitoring will be discussed as part one. Part two involves the monitoring of the hearing aid fitting. Table 4.8 summarises the results from questions 31 and 32 regarding the monitoring of these results and demonstrates findings by making use of figures 4.27 and 4.28.

Table 4.8 Monitoring of the audiologic findings and the hearing aid fittings

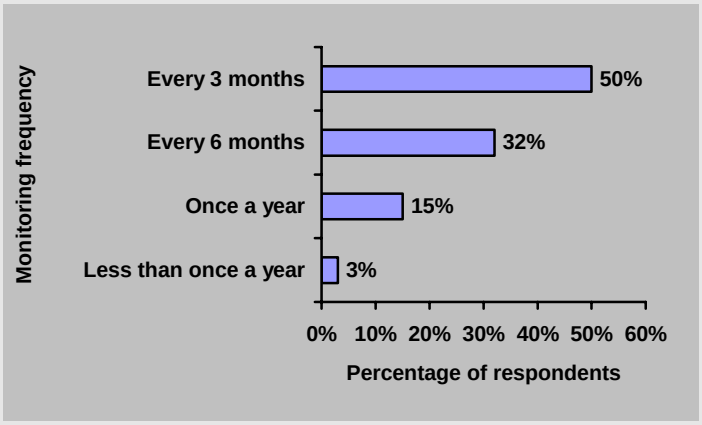
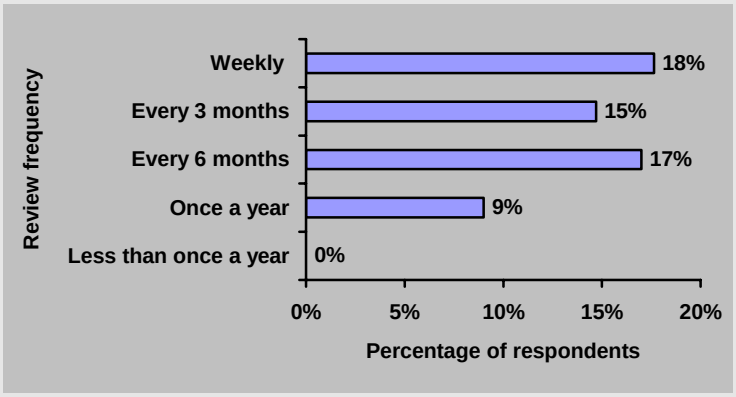
Discussion of results:	Graph:
• In view of this graph, figure 4.27, it is apparent that 50% of respondents monitor the audiologic finding every three months for newly diagnosed infants with hearing loss. • 32% review the finding every six months. • 15% review it once a year and • 3% review it less than once a year.	

Figure 4.27 Monitoring of audiologic findings (n=34)

Table 4.8 Continued

Discussion of results:	Graph:
• From this graph, figure 4.28, it is apparent that 18% of respondents review the hearing aid fittings once a week for newly diagnosed infants with hearing loss, • 41% review it monthly, • 15% review it every three months, • 17% review it every six months, • 9% review it once a year. • There was no respondent who indicated that they review the hearing aid fitting less than annually.	 **Figure 4.28 Review of hearing aid fittings (n=34)**

According to the results discussed in table 4.8, half of all the respondents monitor the audiologic findings of the newly diagnosed infant with hearing loss every six months or even less frequently. This is a matter of concern in view of the fact that there are several categories of audiologic misdiagnosis that may occur when evaluating the hearing status of the infant (Gravel, 2001: 87).

The most common type of misdiagnosis occurs when a hearing loss is identified correctly, but an incorrect conclusion regarding the type of degree of the impairment is made. The correct diagnosis is fundamental to the accurate, timely and appropriate fitting of hearing aids for infants. Several factors might play a role in the time delay between the monitoring of these findings. Again inaccessibility of these services due to inadequate transport of the parents might play a role (Department of Education, 1997: 11). Factors that might serve as barriers to these services will be highlighted and discussed in section 4.2.5.

Concerning the reviewing of the amplification fitting there seemed to be no definite agreement among responding audiologists. The most agreement (41%) seemed to be for monthly reviewing of the hearing aid fitting for newly diagnosed infants with hearing loss. A South African protocol can serve to guide audiologists in this regard.

4.2.2.3 Quality monitoring as part of the EHI programme

Figure 4.29 illustrates results as obtained from question 36 of the questionnaire. This question revealed whether quality monitoring forms part of the EHI programme of responding audiologists.

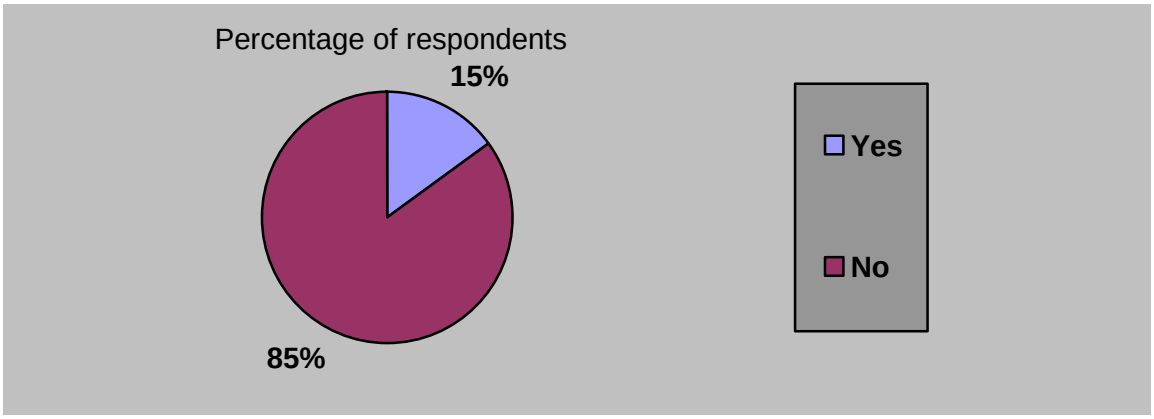


Figure 4.29 System for evaluating each component of the EHI programme (n=34)

According to figure 4.29 by far the majority of responding audiologists do not monitor the quality of their EHI programmes (n=29, 85%). This finding corroborates with results form a survey conducted by Bamford (2001: 334) in which performance of health-based paediatric audiology services in the UK was assessed against existing good practice guidelines (NDCS, 1994 & 1996, as cited in Bamford, 2000: 334). The conclusion of the UK study reads as follows: “There

is clearly considerable variability in service quality. Such variability must reflect inequity of provision, as well as services not fully implementing quality standards guidelines" (Bamford, 2001: 334). It is possible that the absence of quality standards as referred to by Bamford (2001: 334) hinders the evaluation of the EHI programmes. To develop good quality EHI and support programmes, a culture of service evaluation is critical (NDCS, 2002: 5). Equity of quality of the service implies that there is an ethical onus on the service providers to maximise their consistency of practice across the entire programme, guided by existing evidence (Hyde, 2004: 300). EHI services should be *evidence-based* and *quality monitoring* should be a key aspect of this service provision (Bamford, 2001: 329).

The South African year 2002 HSPS document summarises the goals for South African EHDI programmes in four statements (HPCSA, 2002a: 3, 4). The first three refer to the screening for hearing loss, the fourth guideline specifies that quantifiable goals and quality indicators need to be determined for the monitoring and evaluation of EHDI programmes with periodic reviews to assure the quality of such programmes. The Professional Board for Speech Language and Hearing Professions of the HPCSA compiled benchmarks suited to the South African health care system to achieve these goals (HPCSA, 2002a: 5). Although these benchmarks are a helpful guide no early intervention protocol or standard procedure is recommended. South African quality standards for EHI and support services (contextually relevant to the South African context) might alleviate this problem, and help to reduce variation in service provision. South African benchmarks could then be used to evaluate the EHI programme and point to needed next steps in achieving and maintaining quality programmes (JCIH, 2000: 12).

4.2.3 Measurements and equipment

In this section results describing all the measurements used during EHI services and the equipment necessary to perform measurements will be discussed. These measurements include the measurements done to verify and validate the hearing aid fitting. Questions 21 to 28 supplied the information needed and will be discussed in the following section. The interpretation of these results will conclude the section. Figure 4.30 summarises the results from question 21 regarding the measurements used during EHI services by responding audiologists.

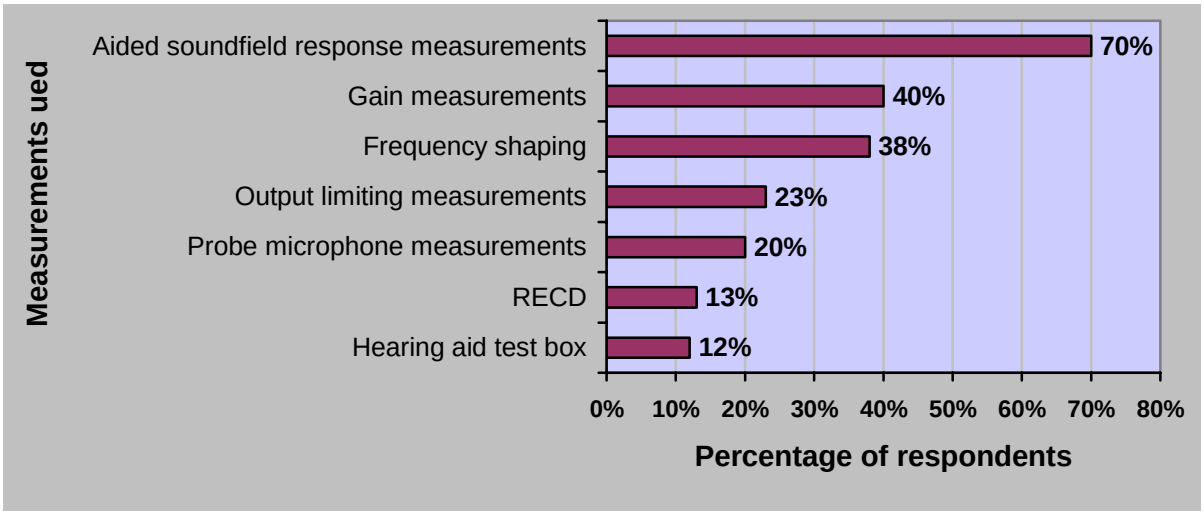


Figure 4.30 Measurements during EHI services (n=40)

According to the results as demonstrated by figure 4.30, the only measurement used by the majority of respondents when fitting infants with hearing aids is *aided threshold measurements* (n=28). Results from question 28 revealed that most respondents who indicated that they use sound field response measurements, use it to validate the aided auditory function when fitting amplification to infants with hearing loss (73%). A few use it when fitting the amplification to verify the frequency and gain response (27%).

A mere 20% of respondents (n=8) indicated that they use *probe microphone measurements* during the fitting of hearing aids for infants with hearing loss.

Results of question 22 regarding the probe microphone measurements revealed the following as reasons why responding audiologists do not use probe microphone measurements for verification of the hearing aid fitting:

- of the respondents who indicated that they do not do probe-microphone measurements, 77% (n=27) indicated that they *do not have the necessary equipment to do these measurements*;
- seventeen per cent (n=6) of the respondents *do not have the experience to do these measurements*;
- six per cent of the respondents (n=2) *do not have the knowledge to do these measurements*.

These results relate to results discussed in section 4.2.2.2 (figure 4.26) where the majority of respondents indicated that they do behavioural audiometric evaluations during the follow-up visits, but very few included probe-microphone measurements as part of the follow-up. The results also corroborate findings from a survey done by Bamford (2000: 155) where almost all respondents included aided threshold measurements, while about 45% included probe microphone measurements. Other findings consistent with these are reported by Hedley-Williams et al. (1996: 107-122) where only 10% of the paediatric audiologists used probe-microphone measurements to verify the fitting of amplification for infants with hearing loss. Bamford (2000: 156) concludes: “While better than nothing, aided thresholds are often a useful source for discussion with parents, but do not reflect the functioning of hearing aids with higher level speechlike inputs, and one would have expected the use of probe tube microphone measures to be more widespread. These findings must be regarded with some dismay.”

Respondents who indicated in question 21 that they do probe microphone measurements (Figure 4.30), indicated that they use 60dB swept pure tones or

speech weighted noise when fitting linear hearing instruments and multiple signal levels when measuring non-linear instruments.

A very small group of respondents (12%, n=6) indicated that they preset the hearing aid in a *hearing aid test box (black box)*. Of the respondents 85% (n=25) indicated that they do not preset hearing aids in a hearing aid test box. In the Standards of Practice in Audiology (HPCSA, 2002: 2) it is stated that hearing aids should include prior checking in a hearing aid test box. As it is a document setting the standards for South African audiologists, it is alarming that this procedure is used by so few of the respondents. It is possible that respondents are unaware of the existence of these standards.

Audiologists who indicated that they use the hearing aid test box when fitting infants with hearing aids, were asked whether they used *prescriptive procedures* developed for children (e.g. DSL (Seewald, 1992)) for guiding hearing aid fittings. Half of the respondents (n=3) indicated that they do as opposed to the other half who used the hearing aid software recommendations. This finding is again consistent with the UK study conducted by Bamford (2000: 156) who found that only 50% of respondents used a hearing aid prescription procedure. A survey of the practice procedures of paediatric audiologists conducted in 1996 by Hedley-Williams and colleagues revealed that only 10% of the paediatric audiologists used a prescriptive approach when selecting the electroacoustic characteristics of hearing aids (Hedley-Williams, Tharpe & Bess, 1996: 110). Less than 10% reported use of the DSL formula. A follow-up amplification survey conducted in 2000 (Tharpe, 2000: 175-190) showed that about 70% of paediatric audiologists use a prescriptive approach when selecting the electroacoustic characteristics of hearing aids compared to the Hedley-Williams and colleagues survey (1996) where only 10% of the paediatric audiologists did (Hedley-Williams, Tharpe & Bess, 1996: 110). The use of a prescriptive approach is especially important for infants and toddlers who are unable to provide reliable information regarding their aided

listening (Stelmachowicz, 2000b: 124). Only the DSL (Seewald, 1988) was designed to specifically account for the many differences between young children and adults (Stelmachowicz, 2000b: 109; Seewald, 1988: 18-22).

The fact that 50% of respondents from the current study rely on hearing aid manufacturers' recommendations when fitting hearing aids to infants is a matter of concern seen in the light of a study conducted by Hawkins & Cook (2003: 26, 28, 32 and 34), demonstrating that relying upon manufacturers' automatic fittings leads to substantially inconsistent fittings. Often these algorithms are proprietary and may not be clearly defined in terms of specific goals or implementation. To apply advances in signal processing to infants who are in the process of developing speech and language, it is important to understand the unique acoustic needs of this population (Stelmachowicz, 2000a: 411). The use of a prescriptive approach is especially important for infants and toddlers who are unable to provide reliable information regarding their aided listening (Stelmachowicz, 2000a: 124).

Reasons supplied by respondents (n=12) who do not use the DSL (Seewald, 1992), but rely on the recommendations of manufacturers' software, are the following:

- the majority of the respondents(n=10), indicated that they *do not have the equipment to do it*;
- one respondent (n=1) *does not have enough time to do it*;
- and another respondent who do not use the DSL (Seewald, 1992) (n=1) indicated that he/she *does not have enough experience to do it*.

Very few respondents (half of the 15% of respondents (n=3) who do preset the hearing aids in a test box) indicated the use of *real ear to coupler difference (RECD) or measurements to verify the output of the hearing aids*. This is a cause for concern when seen in the light of the fact that the sound pressure level in the ear of an infant is significantly greater than the SPL in an adult ear

(Stelmachowich, 2005: 27). As a result of these differences the difference that is associated with real ear measurements for gain and output and coupler values in adults is even greater for children and can be as large as 15 to 20dB (Feigin, Kopun, Stelmachowicz & Gorga, 1989, as cited in Munro, 2005: 71). In general it is believed that the RECD of a child does not approximate adult values until seven years of age (Stelmachowicz, 2000a: 417). It is crucial to account for this expected increase in real-ear SPL when fitting hearing aids to infants and young children (Stelmachowicz, 2000a: 417).

It is clear from these results that responding South African audiologists generally do not offer measurements required for the fitting of amplification of infants. In the context of early intervention, infants will wear their hearing aids at fixed, clinician determined settings for months or years before they are able to clearly express their preferences (Scollie, 2005: 91). If South African audiologists do not verify and validate the fittings with the necessary measurements required for the ultimate fitting, we will not ensure that infants receive consistent audibility of the speech signal at safe and comfortable listening levels (The Pediatric Working Group, 1996: 53).

4.2.4 Amplification devices (material)

Questions 29 to 30 describe the physical characteristics of the hearing aids and material fitted for infants with hearing loss. Hearing aid features that responding audiologists regard as essential when fitting infants, as well as the frequency with which certain materials are used when fitting amplification to infants with hearing loss are illustrated in figure 4.31 and figure 4.32 in table 4.9. The results will be discussed in view of these figures and will be interpreted as a whole at the end of these discussions to conclude section 4.2.4.

Table 4.9 Amplification devices and essential hearing aid features for infants

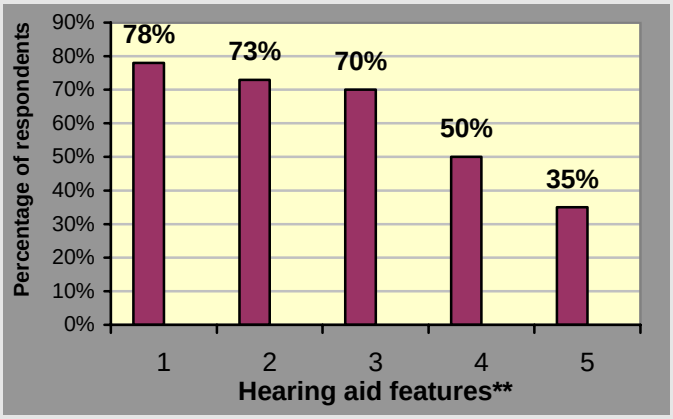
Discussion of results:	Graph:
• According to the figure the majority of respondents regarded direct audio input, tamper resistant volume control and tamper resistant battery compartment as essential features for infant hearing aids. • Only 35% of responding audiologists regarded a telecoil switch as an essential feature. • 50% regarded a microphone-telecoil switch as an essential hearing aid feature for infant hearing aid fittings.	

Figure 4.31 Essential hearing aid features for infants (n=40)

**Hearing aid features:	
1	Tamper resistant volume control
2	Direct audio input
3	Tamper resistant battery compartment
4	Microphone-telecoil switch.
5	Telecoil switch

Table 4.9 Continued

Discussion of results:	Graph:

Interesting findings from figure 4.32 include:

- More than 50% of the respondents indicated that they frequently fit digital hearing aids.
- A combined 56% of responding audiologists seldom or never fit linear analogue hearing aids when fitting infants with amplification.
- A combined 72% of responding audiologists seldom or never fit non-linear analogue hearing aids to infants with hearing loss.
- Behind the ear hearing instruments are always fitted to infants by 94% of respondents.
- A majority of respondents (71%) never fit ITE, ITC or CIC hearing aids to infants with hearing loss.
- Body-worn hearing aids never (91%) fitted by respondents.
- The majority of respondents (88%) indicated that they always or frequently use hearing aids with omni-directional microphones when fitting hearing aids to infants with hearing loss.
- A combined 58% seldom or never select hearing aids with adaptive microphones for infants.
- A combined 53% of responding audiologists seldom or never fit assistive devices to infants with hearing loss.
- More than 80% of respondents use soft moulds for infants.
- Only 29% of respondents routinely supply parents or teachers with a hearing aid kit with at least a stetoclip and air puffer.

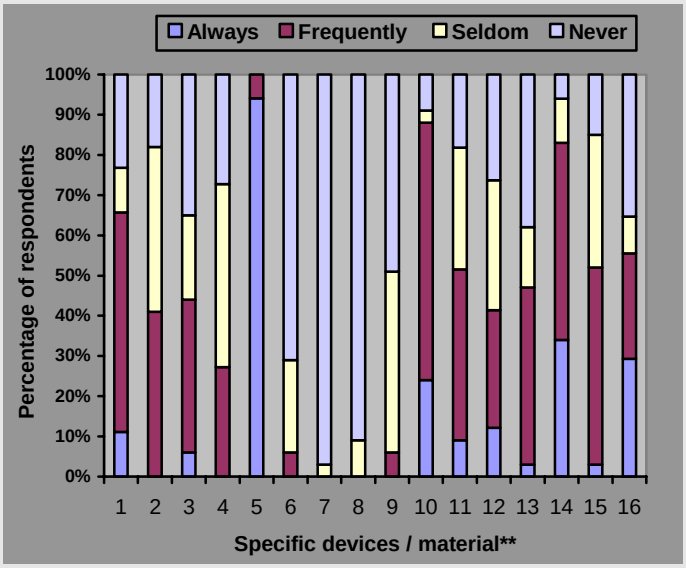


Figure 4.32 Amplification devices/material for infants

** Devices/ material used when fitting infants with amplification	
1	Digital hearing aids (n=35)
2	Digitally programmable analogue hearing aids (n=34)
3	Linear analogue hearing aids (n=34)
4	Non-linear analogue hearing aids (n=33)
5	Behind the ear hearing aids (n=35)
6	In the ear/ in the canal hearing aids (n=31)
7	Completely in the canal hearing aids (n=31)
8	Body-worn hearing aids (n=32)
9	Bone conduction type hearing aids (n=33)
10	Omni-directional microphones (n=33)
11	Directional microphones (n=33)
12	Adaptive microphones (n=34)
13	Assistive listening devices (n=34)
14	Silicon /soft ear moulds (n=35)
15	Hard/ acrylic ear moulds (n=33)
16	Parent/ teacher hearing aid kit with a stetoclip (n=34)

From the results summarised in table 4.9 it seems that digital technology hearing aids were most frequently chosen by respondents for fitting of infants with hearing

loss. This is a positive finding in view of the fact that all hearing aids are likely to be digital within the next five years and the analogue versus digital decision will be irrelevant (AAA, 2003: 10). These results are in contrast, however, with findings from a survey conducted by Bamford et al. (2001), comparing good practices in the UK and USA. Results of that study indicated that very few DSP (digital signal processing) hearing aids are fitted (Bamford et al, 2001: 214). Two of the possible reasons for the difference in the findings will be discussed.

Firstly, as technology advances at such a rapid pace, it is possible that audiologists in the UK/ USA study had fewer and different DSP hearing aids available in 2000 when the study was conducted. The current questionnaire survey was sent out in 2004, four years later. With advances in technology more and different DSP hearing aids are available for fitting infants with hearing loss to audiologists in the current study.

Secondly, the majority of respondents from the current study work in private practices (65%, n=26) where financial constraints are less likely to play a role in service delivery. Respondents from the USA and UK indicated that the high costs of these hearing aids had "quite a lot" of influence on the use of DSP hearing aids (Bamford, 2001: 217). In South Africa the public sector is under-resourced and over-used, while the private sector caters to middle and high income earners who tend to be members of medical schemes (Retrieved on 10 May, 2005, from http://www.southafrica.info). Because of the small sample sizes of respondents in different working sectors, it was not possible to do inferential statistics in search of a correlation between these findings and the sector the respondents are working in. This might explain the discrepancy between these results and the UK/USA survey's results.

Of the analogue technologies available responding audiologists seemed to be least likely to fit non-linear analogue hearing aids when fitting infants with hearing loss.

Linear signal processing implies that a volume control is not only included, but is manipulated by the user as one assumes that the user would need to turn down more intense inputs and turn up quiet inputs to maintain audibility and comfort (AAA, 2003: 9).

According to the rating of South African respondents by far the most frequently fitted type of hearing aids for infants seemed to be the BTE type. To fit BTE hearing aids to children is appropriate as BTE instruments are more durable, the outer ear continue to grow well into puberty, BTE is less likely to produce feedback when fitted with an appropriate ear mould and allows for a variety of features that may be essential for the infant (AAA, 2003: 5). There seemed to be agreement among responding audiologists that a tamper resistant battery compartment and volume control are essential features of the hearing instruments fitted to infants.

Omni-directional microphones seemed to be used mostly by responding audiologists when fitting hearing aids to infants. This correlates with findings from international studies that directional technology is seldom used in the fitting of the young child (Buerkli-Halevy & Checkley, 2000: 83).

Hearing instruments with adaptive microphones are seldom or never used by respondents when fitting infants with hearing aids. The use of this flexible technology might however help to address issues of continual changing amplification needs (Buerkli-Halevy & Checkley, 2000: 85).

Respondents seem to be divided on the question of fitting assistive devices to infants with hearing loss or not. While the information about FM systems may affect hearing aid choices made, it may be several months before the family of the infant with hearing loss is ready to implement a plan for addition of the FM to the child's listening environment. FM systems are not commonly used for infants, and there are very few studies that examine this application (Gabbard, 2005: 156).

When an infant becomes an active toddler it becomes appropriate to consider an FM system (Gabbard, 2000: 94). The fact that these options are mostly not considered during the initial fitting might have influenced respondents' response to this questionnaire item. It is, however, apparent from the results, indicating that 73% (n=29) of respondents consider direct audio input as an essential hearing aid option when fitting infants with hearing aids, that hearing aid choices are influenced by possible later use of assistive devices.

The fact that responding audiologist seemed to be so divided in the frequency with which they supply parents or teacher with hearing aid care kit, is cause for concern. Not giving parents tools for maintenance and care can lead to infants wearing faulty hearing instruments and ultimately hindering full-time and consistent audibility of the speech signal.

4.2.5 Mother Nature

Even though the international guidelines assisted in setting a framework for the interpretation of the results describing the nature and scope of EHI and support services rendered to the infant with hearing loss in South Africa, it is essential to keep the unique difficulties of South African audiologists in view.

In this section results from question 17, supplying information about the unique factors that influence the EHI programme, will be discussed. Figure 4.33 summarises results obtained from question 17.

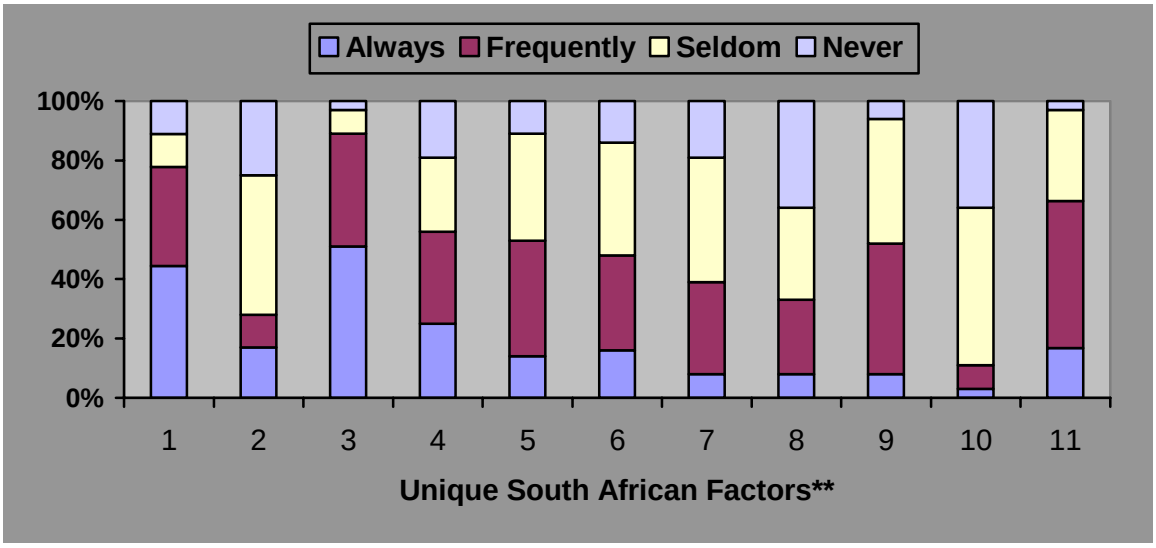


Figure 4.33 Unique South African factors influencing EHI programmes (n=36)

**Unique South African Factors	
1	Geographical aspects (e.g. accessibility of health service)
2	Climate (e.g. moist, hearing aid breakage as a result)
3	Financial constraints of the family
4	Financial constraints of the practice/ clinic/ hospital
5	Cultural diversity (e.g. how culture views disability)
6	Language differences between service provider and family
7	Lack of language interpreters
8	Absence/ inadequacy of deaf role models
9	Educational levels of the family/ caregivers
10	Religious diversity
11	Infant/ family support system

From the results demonstrated in figure 4.33, there seemed to be agreement among participants that the following aspect always or frequently influence the service delivery to infants with hearing loss: A*ccessibility of health services*, *financial constraints of the family* and *the infant/ family support system*. There is also agreement that *climate, religious diversity* and the *absence or inadequacy of deaf role models* seldom or never play a role in service delivery. There seemed to be diverse opinions about the role of the *financial constraints of the practice/clinic/hospital, cultural diversity* and *language differences between service provider and family in the provision of EHI services*.

Factors that always or frequently influence the service delivery to infants with hearing loss, which is the accessibility of health services, financial constraints of the family and infant or family support system will be discussed firstly.

- *Accessibility of services*, that seems to be a factor frequently influencing the EHI and support services rendered by respondents of this study, might be hindered firstly by inadequacy or non-existence of the services or facilities and secondly inadequate transport to the facility (Department of Education, 1997: 12). In most cases, inadequacies in provision are linked to other inequalities in the society such as urban/ rural disparities. For example, infants with hearing loss and their families might be unable to reach clinics or practices where EHI services are provided because there are no transport facilities available or the roads are so poorly developed and maintained that these clinics cannot be reached. The fact that EHI services are thus not easily accessible might hinder the timely fitting of amplification, as well as frequent follow-up visits to monitor audiologic findings and hearing aid fittings.

- The most obvious effect of *financial constraints on the family of the infant* with hearing loss is the inability of families to meet the intervention needs of the infant with hearing loss. Extreme income inequality is evident in the form of poverty side by side with affluence (Swanepoel, 2004: 118). In South Africa unemployment is a reality resulting in poverty affecting almost 50% of South Africa's population, which results in the family not being able to meet even the basic needs of the infant such as nutrition and shelter (Department of Education, 1997: 13). Socio-economic pressures on families of infants with hearing loss result in a priority shift within the family from attending to the rehabilitation of a disability to dealing with more basic needs of nutrition, for example. Even if intervention can be supplied at no cost and hearing aids are subsidised by the government, maintenance of the hearing aids (such as battery replacements) might be impossible for the parents to afford. As a result of the financial

difficulties of the families of infants with hearing loss, amplification choices are limited and advances in technology become a theoretical possibility. Financial constraints, or in its extreme form poverty, of the family of the infant with hearing loss is an ever-present barrier that will impede the delivery of EHI and support services to the majority of South Africans and should therefore be carefully considered for future implementation of these services.

- The lack of an *infant or family support system* might have far-reaching effects on the development of the infant with hearing loss. The active involvement of parents and the broader community in the learning process is central to effective development of the infant with hearing loss (Department of Education, 1997: 18). The lack of parental involvement in EHI centres might be due to negative attitudes towards parental involvement, lack of resources to facilitate such involvement, lack of parent empowerment and support for parent organisations (Department of Education, 1997: 18). The aim of the government is to promote the health of all South Africans through a national health system that is based on the primary health care approach (Department of Health as cited in Petros, 2001:6). The basis of this approach is found in the philosophy of “ubuntu”. The ubuntu philosophy holds that all people should be treated with respect and dignity, because a person becomes a person through other people. (Louw, 2005: 2). Good health is seen as a prerequisite for social and economic development, and government and all associated health institutions should form strong partnerships to ensure steady improvement in quality of care (Health Sector Strategic Framework, 1999-2004 as cited in Petros, 2001: 7).

- The differing opinions when rating the frequency with which *financial constraints of the practice, clinic or hospital* influences service delivery to infants with hearing loss in South Africa can be explained by the dualistic nature of the healthcare system of South Africa. On the one hand the under-resourced public sector might experience different problems compared to the wealthier, smaller

private sector. The vast majority of audiologists in South Africa is in private practice and provide services to a small minority of the country (Swanepoel, 2005: 131). This is also true of the current study as 60% of the respondents work in private practice and another 30% in government clinics (see section 3.5.3). Due to the small number of respondents working in some sectors, it was not possible to do inferential statistics (S. Human, Department of Statistics, UP, personal communication, October 2004). A possible correlation between the working sector of respondents and their rating of the frequency with which financial constraints of their practice or clinic influence service delivery could thus not be investigated. In South Africa the majority of the population cannot afford audiological services in private practices and have to rely on the under-resourced national health care system for provision of these services (Swanepoel, 2004: 131). The limited availability of resources in this system creates barriers to the acquisition of equipment and personnel for EHI programmes. Certain measurements, known to be best practice, are not available as a result of this. The quality of the service provision to these infants is jeopardised, leading to and amplifying inequality of service provision in South Africa.

- The differences between the populations served by the private practices and those served by the national health care system might also give insight into respondents' different ratings of the role of *cultural diversity and language differences between audiologists, as service providers, and the infant's family* in the provision of EHI services. Respondents seem to be divided in their rating of the frequency with which these factors play a role in their service delivery (figure 4.34). Private practices typically cater for middle and high income earners and the national health care system provides services to lower income earners (Petros, 2001: 7). Although poverty is not confined to one racial group in South Africa, it is concentrated among blacks who constitute approximately 80% of the total population of South Africa speaking one of its nine official black languages (Swanepoel, 2004: 118). The minority of people in South Africa are mother-

tongue speakers of English and Afrikaans, and so far only a small percentage of mother-tongue speakers of an African language have qualified as audiologists (Uys & Hugo, 1997: 24). Thus, the majority of the infants who will receive EHI services from audiologists in government clinics or hospitals, will not speak the same language or have the same culture as the audiologists who will supply EHI services to these infants and their families. These multilingual and multi-cultural characteristics of the South African population create a unique challenge for the South African audiologists. The goal of providing information to parents in their preferred language as set by the NDCS in their Quality Standards in the Early Years (2002: 28) creates a very real challenge to South African audiologists.

4.3 RESULTS OF SUB-AIM TWO

To evaluate these EHI services against international professional best practice protocol

Sub-aim two of this study aims to evaluate EHI services rendered to infants with hearing loss by South African audiologists after the diagnosis of hearing loss against international professional best practice protocol. Results will be organised in table format to aid comparison of these results with the stated benchmarks. Table 2.3 was used as the foundation for the development of table 4.10. Benchmarks are used to evaluate progress and to point to needed next steps in achieving and maintaining a quality programme (JCIH, 2000: 12). Through the literature review (chapter two) benchmarks were defined against which EHI can be evaluated. The following table provides these benchmarks that delineate good quality EHI services, gathered from the international evidence base opposed to the results from the study.

Table 4.10 Results from the current study evaluated against the international best practice guidelines (Benchmarks)

BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES	RESULTS FROM CURRENT STUDY
1. MAN **This category should include everyone involved in EHI services.**	
1.1 The audiologist / EHI specialist	
• The audiologist should have experience of the assessment and management of infants and children with hearing loss and the commensurate knowledge of current pediatric hearing aid selection and evaluation procedures (The Pediatric Working Group, 1996: 53; JCIH, 2000: 10). • EHI specialists should be trained in: o working in partnership with parents, o working in partnership with other professionals o hearing loss, o early child development, o the development of language and communication, o audiological support, o emotional support and counselling skills, o providing accurate and unbiased information, o monitoring progress, o managing/ coordinating service delivery to families, multiprofessional working o cultural and religious diversity (JCIH, 2000: 18).	• Respondents indicated that they are trained in: o visual communication training, o auditory communication training, o providing accurate and unbiased information, o counselling skills, o working in partnership with parents to form a family-centred EHI programme, o speech and language assessment procedures, o paediatric audiologic assessment procedures (infants nought to three years), o effects of hearing impairment on language and communication development of the child, o early childhood development and o working in partnership with other professionals. • Respondents indicated that they are not trained in (figure 4.3): o performance of paediatric hearing aid fittings, o the monitoring of paediatric hearing aid fittings, o the description, performance, and interpretation of behavioural measures of performance with hearing aids, o the performance and interpretation of measures of electroacoustic characteristics of hearing aids, o the performance and interpretation of measures of electroacoustic characteristics of assistive listening devices, and o paediatric hearing aid selection procedures.

Table 4.10 Continued

BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES	RESULTS FROM CURRENT STUDY
1.2 The infant or child with hearing loss	
• Infants with hearing loss are enrolled in a family-centred early intervention programme before six months of age (JCIH, 2000: 11).	• Respondents indicated that most infants with hearing loss are enrolled in an EHI programme after six months of age (figure 4.14).
• An infant needs hearing aids when there is a significant, permanent, bilateral peripheral hearing loss (25dB or more in the 500 Hz through 4000 Hz region) (The Pediatric Working Group, 1996). Children with permanent bilateral hearing loss should be provided with two hearing aids, unless there are justifiable contra-indications (NDCS, 2000: 54).	• Respondents indicated that infants with bilateral hearing loss are typically fitted with hearing aids binaurally (figure 4.15).
• The early years support services should be available immediately when hearing loss is confirmed (NDCS NDCS, 2000: 14; NDCS NDCS, 2002: 11).	• Respondents indicated that EHI support services are typically not available immediately after confirmation of hearing loss (figure 4.16).
• Infants with hearing loss and no medical contra-indication begin use of amplification when appropriate and agreed on by the family within one month of confirmation of hearing loss (JCIH, 2000: 18; NDCS, 2000: 14).	• Respondents indicated that infants are typically fitted with hearing aids one month after confirmation of hearing loss (figure 4.17)
1.3 Family or caregivers	
• Parents should be fully involved in deciding on the support and intervention of their child with hearing loss, as well as monitoring and evaluating the effectiveness of this provision (NDCS, 2002: 13).	• Respondents indicated that parents are involved in the deciding of the support and intervention for their child with hearing loss, but not in the monitoring and evaluating of the effectiveness of this provision (figure 4.18).

Table 4.10 Continued

BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES	RESULTS FROM CURRENT STUDY
• Regarding the planning and delivering of the support to the family the following should be considered: Early intervention services should be shaped to meet the individualised needs of the infant and family, including addressing acquisition of communicative competence (in the family's chosen communication mode), diverse demographics, social skills, emotional well-being, and positive self-esteem (Karchmer & Allen, 1999, as cited in NDCS, 2002: 13). It should not remain static, but should be reviewed every six months.	• Respondents indicated that EHI services are typically shaped to meet the individualised needs of the infant and family (figure 4.22).
• Parents should be given information about relevant support groups or charities (NDCS, 2000: 12)	• Respondents indicated that parents are typically not always informed about relevant support groups (figure 4.19).
• Parents should be given copies of audiograms and other audiological assessments, with a full explanation (NDCS, 2000: 12).	• Respondents indicated that information is typically documented (figure 4.20).
• Documented discussion should occur about the full range of resources in early intervention and education programmes for children with hearing loss (JCIH, 2000: 17).	
• Families participate in and express satisfaction with self-advocacy (JCIH, 2000: 17)	• Respondents indicated that parents are often not advocating for the child (figure 4.19).
1.4 Team members	
• A true multidisciplinary team should include parents and named individuals from all services, supporting the infant with hearing loss.	• Respondents indicated that the following members typically form part of the EHI team: The infant with hearing loss, the infant's parents, the paediatrician, the speech language pathologist and the ear, nose and throat specialist (figure 4.21).
• Essential team members are families, paediatricians, audiologists, ear, nose and throat specialists, speech-language pathologists, educators of children with hearing loss, and other professionals involved in delivering EHI (JCIH, 2002: 17).	• Other parents are typically not part of the EHI team.

Table 4.10 Continued

BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES	RESULTS FROM CURRENT STUDY
2. METHOD	**This refers to the systematic procedures or protocols used during all the components of the EHI services (JCIH, 2000, p.13).**
2.1 Regarding the EHI programme	
• All components of the EHI programme should be provided using a systematic, quantifiable and evidence-based approach (The Pediatric Working Group,1996: 53). • Quality should be assured through available benchmarks and standards for each stage of the EHI process (JCIH, 2000: 24). • The following components should form part of the EHI programme (JCIH 2000: 17): o Developing an individualised family service plan (incorporating the family's preferences for outcomes). o Selection of amplification. Fitting of amplification. o Selection of assistive technology. Fitting of assistive technology. o Verification of the fitting. o Ongoing monitoring of the findings: ✓ Infants with amplification receive ongoing audiologic monitoring at intervals not to exceed three months (JCIH, 2000:17). ✓ Hearing aid fitting and assessment should be reviewed weekly for newly diagnosed babies, and every two months once hearing aid provision has been established for the first two years of using amplification and every 4-6 months after that time (NDCS, 2000: 14, The Pediatric Working Group, 1996: 56).	• Results reveal variation in the nature and scope of most components regarding the EHI programmes in which respondents are involved. • Respondents revealed that they do not evaluate the EHI programme (figure 4.29). • The following components typically form part of the EHI programmes in which the respondents are involved (figure 4.23): o Developing an individualised family service plan (incorporating the family preference for outcome). o Selection of amplification. o (Selection of assistive technology and fitting of assistive technology is typically *not included*). o Verification of the fitting. o Ongoing monitoring of the fitting. ✓ Respondents indicated that audiologic findings are typically monitored at intervals exceeding three months (figure 4.27). ✓ Respondents seemed to disagree regarding the monitoring of hearing aid fittings of newly diagnosed infants; the biggest group indicated monthly review (figure 4.28).

Table 4.10 Continued

BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES	RESULTS FROM CURRENT STUDY
o Family education and counselling. o Participate in the assessment for candidacy for cochlear implantation. Provision of direct auditory rehabilitation services (e.g. auditory and speech training). ✓ The audiologist should, together with the speech-language pathologist and other team members, provide language and communication assessments as well as training (for receptive as well as expressive language development). This should include auditory, visual, auditory-visual training (e.g. speech reading, auditory training, listening skills) depending on the families' preferred communication mode (ASLHA, 2002:92, NDCS, 2000: 17). o Working in a multidisciplinary team (The Pediatric Working Group, 1996: 54; Pediatric Amplification Protocol, 2003: 1-10).	o Family education and counselling. o (Participation in the assessment of candidacy for cochlear implantation is typically *not included*). Direct auditory rehabilitation: ✓ Respondents indicated that they either provide communication assessments as well as training or refer to other team members (figure 4.24). o Working in a multidisciplinary team.
2.2 Follow-up visits	
• Follow-up visits should include: o Behavioural audiometric evaluations. o Current assessment of communication abilities, needs, and demands. o Adjustment of the amplification system based on updated audiometric information and communication demands. o Periodic electroacoustic evaluations. o Listening checks. o Earmould fit checks. o Periodic probe-microphone measurements. o Periodic functional measures to document development of auditory skills follow-up including academic progress (with the multiprofessional team. o (Pediatric Amplification Protocol, 2003: 1-10).	• Respondents indicated that follow-up visits typically (more than 60% of responses) *include* (figure 4.26): o Behavioural audiometric testing. o Assessment of communication abilities, needs and demands. o Adjustment of the amplification system based on updated audiometric information and communication demands. o Listening checks. o Ear mould fit checks. • Approximately *half of the respondents include* the following as part of the follow-up: o Functional measures. o Long-term follow-up (through interdisciplinary evaluations). • The following components are typically *not included* as part of the follow-up visits (less than 30% of respondents): o Electroacoustic evaluations. o Probe-microphone measurements.

Table 4.10 Continued

BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES	RESULTS FROM CURRENT STUDY
3. MEASUREMENT	**This would include all measurements during the early intervention services rendered to children with hearing loss (audiometric measurements included).**
3.1 Selection and verification of electroacoustic characteristics of amplification	
• Probe-microphone measurements of real-ear hearing aid performance should be obtained with children whenever possible (The Pediatric Working Group, 1996: 55).	• Probe-microphone measurements are typically not measured by respondents (figure 4.30).
• Target values for frequency/gain and frequency/output limiting characteristics should be selected according to standard prescriptive procedures designed for children (e.g. Desired Sensation Level, Seewald, 1992; NDCS, 2000:18).	• Standards prescriptive procedures are typically not used for selecting target values for frequency/gain and frequency/output characteristics (figure 4.30).
• The hearing aid should be preset in a hearing aid test box using published or preferably measured Real Ear to Coupler Difference (RECD) values (The Pediatric Working Group, 1996:55).	• Respondents indicated that they do not use hearing aid test box or RECD measurements for presetting the hearing aids (figure 4.30).
• Measurements to verify output limiting include the direct measurement of the real ear saturation response (RESR)	• Respondents do not verify the output limiting of the hearing aids (figure 4.30).
3.2 Validation of aided auditory function	
• Aided auditory function should be measured using aided soundfield responses (The Pediatric Working Group, 1996: 55). • Questionnaires could be used to validate the fitting.	• Aided auditory function is typically used as measurement for the fitting of amplification to infants with hearing loss (figure 4.30).

Table 4.10 Continued

BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES	RESULTS FROM CURRENT STUDY
4. EQUIPMENT: (MACHINE)	**This category includes all the audiological equipment necessary to do the measurements during EHI services.**
4.1 Selection, verification and the validation of the hearing aid/ assistive listening devices fitting	
• Equipment to do probe-microphone measures and electroacoustic evaluations, hearing aid black box (AAA, 2003: 13). • Audiometer for the validation of auditory function with amplification: Calibrated annually using the manufacturer's specifications or ANSI S3.39-1987 (HPCSA, 2002b: 2).	• The lack of equipment to do probe-microphone measurement was given as the main reason why respondents do not do these measurements (section 4.2.3).
5. AMPLIFICATION DEVICES (MATERIAL)	**Apparatus necessary in the EHI process.**
5.1 Hearing aids	
• Hearing aids for most children should include direct audio input (DAI), telecoil (T), and microphone-telecoil (M-T) switching options. • In general, behind the ear (BTE) hearing aids with safety-related features (such as tamper resistant volume and battery controls) are the style of choice for children under eight years (The Pediatric Working Group, 1996: 54). • Ear moulds for use with BTE hearing aids should be constructed of soft material (The Pediatric Working Group, 1996: 54). • Electroacoustic performance of the hearing aids should be checked every six weeks in accordance with IEC standards.	• Respondents indicated that hearing aids for infants typically include DAI but not T or M-T options (figure 4.31 in table 4.9). • Respondents typically chose BTE hearing aids with safety-related features such as tamper resistant volume and battery controls (figure 4.31 and figure 4.32 in table 4.9). • Ear moulds used by the respondents are typically constructed of soft material (Figure 4.32 in table 4.9). • Respondents do not have the equipment to do these measurements (section 4.2.3).

Table 4.10 Continued

BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES	RESULTS FROM CURRENT STUDY
• A flexible, wide dynamic range compression hearing aid with low distortion is preferable. The unique combination of decisions will lead to the selection of particular hearing aids for a particular child. (Pediatric Fitting Protocol, AAA, 2003: 13).	• Respondents seemed to fit digital hearing aids most frequently when fitting infants with hearing loss (figure 4.32 in table 4.9).
• Parents and teachers should be provided with a hearing aid kit that should include at least a stetoclip and air puffer for daily maintenance (NDCS, 2000: 15).	• Respondents seldom supply a hearing aid kit to parents of infants fitted with hearing aids (figure 4.32 in table 4.9).
5.2 Assistive listening devices	
• FM systems can be considered. • FM system fitting should be verified electroacoustically (JCIH, 2000: 19).	• Most respondents seldom or never fit assistive listening devices to infants with hearing loss (figure 4.32 in table 4.9).
5.3 Cochlear implants	
• Parents should be informed and referred to specialised team members (NDCS, 2000: 17).	• Very few respondents indicated that they are involved in the assessment for cochlear implantation (figure 4.23).

Table 4.10 Continued

BENCHMARK FROM INTERNATIONAL BEST PRACTICE GUIDELINES	RESULTS FROM CURRENT STUDY
6. MOTHER NATURE	**This category includes: The natural environment (geographic and topographic aspects, climate, atmosphere and weather patterns), the manmade physical environment and the socio-cultural environment.**
• The natural environment (geographic and topographic aspects, climate, atmosphere and weather patterns). • The manmade physical environment. • Socio-cultural environment. o Financial constraints. o Accessibility of health services (fewer professional resources, deaf role models, sign language interpreters). o Educational levels of family or caregivers.	
• These factors underscore the necessity of providing comprehensive, culturally sensitive information to families in the individualised EHI plan (JCIH, 2000:18). • Parents should receive all information in their preferred language. Interpreters should be provided if necessary (NDCS, 2002: 16).	• Respondents indicated that they shape the EHI curriculum to respond to the individualised needs of the infant with hearing loss and his/ her family (figure 4.29). • Respondents indicated the following factors as frequent or consistent barriers to the timely delivery of high quality EHI services: o The lack of an infant/ family support system. o Financial constraints of the family. o Geographical aspects (e.g. accessibility of health service).

Table 4.10 provides a detailed comparison between results obtained through this study and benchmarks derived from international best practice guidelines. Some interesting results from table 4.10 will be highlighted. Respondents indicated that they were trained in several areas necessary for EHI, in accordance with the stated benchmarks. A lack of undergraduate training in all the areas of current paediatric hearing aid selection and evaluation procedures, where best practice guidelines call for knowledge, were pointed out by the respondents. With regard to the hearing aid selection and evaluation process results also reveal that measurements such as electroacoustic and probe-microphone measurements are typically not

done as stipulated by the benchmarks. Respondents indicated that they do not have the equipment necessary to do these measurements. In agreement with the benchmarks, digital sound processing was the technology of choice when selecting hearing aids for infants.

Table 4.10 depict that, opposed to best practice guidelines and the stated benchmarks, infants are typically not enrolled into EHI programmes before six months of age and EHI services are not available immediately after confirmation of the hearing loss. As called for by the international guidelines and in accordance with the benchmarks EHI programmes of the respondents are multidisciplinary and shaped to meet the individualised needs of the infants and their family. Benchmarks solicit that information regarding support groups are given to parents; respondents indicated however that this is typically not done.

International guidelines call for rehabilitation services to be included as part of the EHI programme. Respondents were divided, however, with half the respondents performing these services and the other half referring to other team members for these services. Contrary to the benchmarks respondents do not evaluate the EHI programmes that they are involved in, nor do they involve parents in this process. As reminded by the international guidelines, the influence of Mother Nature on the provision of EHI services underscore the necessity of providing comprehensive, culturally sensitive information to families in the individualised EHI programme. Several barriers to the provision of EHI services, unique to the South African context, were identified by the respondents namely: The lack of an infant/ family support system, financial constraints of the family and factors hindering access to timely EHI services. As highlighted in the discussion, table 4.10 reveal the lack of consistent practice, aligned with international benchmarks, with regard to most areas of EHI services.

There may several reasons why the EHI services rendered by the respondents are not aligned with these international benchmarks:

Firstly it is possible that audiologists are not aware of evidence-based protocols or guidelines for EHI services. Hedley-Williams and colleagues (1996: 120) have suggested that report findings in support of systematic hearing aid procedures for children may not be reaching the clinicians. This might be true despite the fact that respondents have rated literature as a significant source of knowledge in EHI (table 4.5). Regular survey of the current scientific journals is a formidable challenge, as "new research proliferates at a mind-numbing rate" (Rosenfeld, 2003, as cited in Gravel, 2005: 19). According to Thorne (2003, as cited in Gravel, 2005: 20) there were 1700 articles available in audiology in 2003. Clearly there is a need to be selective regarding the articles or literature in search of "good" evidence.

Secondly, as suggested by Hedley-Williams et al. (1996: 120) clinicians may be aware of the research findings but may not have access to the equipment need to conduct these procedures. This is a very likely explanation for the disagreement between the international benchmarks and the EHI services rendered by the respondents. The lack of equipment was the most frequently cited barrier to the use of evidence-based measurements (table 4.10 *Equipment*). The financial constraints of the family of the infants in South Africa, as pointed out by the respondents might spiral down to cause under-resourced clinics and subsequently a lack of equipment to engage in evidence-based procedures for EHI services.

Thirdly, respondents might find that these best practices are not as easy or efficient as they appear in the literature and subsequently reject them (Hedley-Williams et al. 1996: 120). This is a very likely scenario for South African audiologists as much of the international guidelines are based on what worked in

developed countries and not in developing countries, such as South Africa (Foster & Anderson, 1987, as cited in Hugo, 1990: 8).

4.4 SUMMARY

The results as discussed and interpreted in chapter four aimed to describe the nature and scope of early hearing services rendered to infants with hearing loss by South African audiologists. Within the context of a descriptive research design, questionnaires were used to obtain quantitative and qualitative data regarding the nature and scope of EHI and support services rendered by the respondents.

In line with the principle of service evaluation and quality monitoring as specified by the JCIH position statement (JCIH: 11) and endorsed by the Professional Board for Speech Language and Hearing Professions of the HPCSA (HPCSA, 2002: 5) the aims of this study were formulated. The information obtained from the questionnaires served to describe the nature and scope of EHI and support services rendered to infants with hearing loss by South African audiologists. The research further aimed to evaluate these services against benchmarks obtained from the international body of knowledge and interpret these findings in the light of the unique factors influencing the rendering of these services in South Africa. An important motivation for the current and other South African research is supplied by Swanepoel (2004: 133): “The necessity for local research to sustain and develop the profession of audiology in South Africa has, however, become more prominent with and increases the emphasis on providing relevant and accountable services for the entire population”. In South Africa there are limited data available on current practice patterns of audiologists serving the paediatric population.

The provision of quality hearing health care to children will be compromised if audiologists practice clinical procedures that are not supported by valid published

data (Hedley-Williams, Tharpe and Bess, 1996: 107). In a time of health care reform with emphasis on cost containment, outcome and efficacy the need for evidence-based clinical procedures becomes increasingly important. The results from this study suggest that for the most part respondents do not use systematic procedures consistently during EHI and support services rendered to infants with hearing loss. Several reasons for this finding were discussed. To summarise, they are: Firstly, reports of research findings in support of systematic EHI procedures may not be reaching the South African audiologists (Hedley-Williams, Tharpe and Bess, 1996: 120), secondly, audiologists might be aware of the research, but the unique difficulties attributed to the South African context might hinder the provision of quality EHI and support services aligned with international best practice guidelines. Thirdly, a lack of the equipment, knowledge or expertise needed to conduct these high quality services might be the reason why systematic procedures are not used. These results have generated a number of contextual recommendations that will be discussed in chapter five.

CHAPTER 5
CONCLUSIONS AND IMPLICATIONS

Aim: To draw general conclusions and derive implications from the research findings, critically evaluate the research and make recommendations for further research.

"A thinker sees his own actions as experiments and questions - as attempts to find out something. Success and failure are for him answers above all."
Friedrich Nietzsche (1844-1900)

5.1 INTRODUCTION

Developing and maintaining good quality EHI services is crucial for ensuring the quality of life of all infants in South Africa with hearing loss. This is a major challenge however (Bamford, 2000: 359), and uniquely so for the South African infant with hearing loss. The quality of early intervention services for children with hearing loss in South Africa will be influenced by international benchmarks as well as the unique South African situation. Using international best practice guidelines to steer EHI services in South Africa, is in line with the first objective of the mission statement of the Professional Board of Speech, Language and Hearing Professions of South Africa, namely to "*set a new professional practice framework in place, aligned with international professional best practices*" (HPCSA, 2003:1).

In order to align EHI services in South Africa with international best practice, audiologists must have a strong commitment to keep up to date with methods, technologies and interventions reported in the field's scientific journals and

continually incorporate relevant, well executed research literature into clinical practice (Gravel, 2005: 18). This commitment is essential to steer evidence-based practice in EHI services. Gathering the relevant evidence necessary for development of good quality EHI services in South Africa is reliant on research endeavours that meet the unique local demands of the South African population and context in a socially and economically justifiable manner (Hugo, 1998: 12).

Addressing this responsibility the current study aimed to describe EHI services rendered to infants with hearing loss by South African audiologists and to place it within the sphere of international best practice. In support of evidence-based practice the present research study expected to provide research-based recommendations for use in clinical practice.

Within this broader aim the specific aim of this chapter is therefore to draw general conclusions and implications from the results of the empirical study, to critically evaluate the research and to make specific recommendations from the empirical research conducted during this study for the development and maintenance of good quality EHI services in South Africa. Recommendations are made to initiate further research and guide future clinical practice.

5.2 CONCLUSIONS

The empirical research was conducted according to two sub-aims, which resulted in the summarised conclusions that follow below:

5.2.1 Conclusions from Sub-aim one:

To determine the nature and scope of EHI services provided by South African audiologists to infants with hearing loss and their families

For the purpose of this study, causes of variation were categorised using the so-called "six M's": Man, machine (equipment), method, material (amplification devices), measurement and Mother Nature (Leansigmatech, 2003: 2). Results revealed variations in all six the categories regarding many factors of the EHI programmes that respondents are involved in. It seems that clinical practices are not consistent and that in general defined protocols are not used. Considering these six M categories the following conclusions are drawn from the results:

Man: The South African audiologist

- Many audiologists indicated that they perceived their undergraduate training to be inadequate with regard to all the stages of paediatric hearing aid fitting. These stages include the selection of hearing aids, verification and validation of the hearing aid fitting. Training in the verification of the fitting of assistive listening devices was also perceived as inadequate.

- Most audiologists indicated that they consider postgraduate seminars to be a very important and significant source of knowledge in EHI.

Man: The infant with hearing loss in South Africa

- From the results it seems that very few infants with hearing loss are enrolled in an EHI programme by six months of age.

- EHI and support services are typically not available to infants immediately after the confirmation of the hearing loss, and hearing aid fitting commences only after a month after confirmation.

- Infants with bilateral hearing loss are typically fitted with hearing aids binaurally.

Man: Family of the infant with hearing loss

- There seems to be general agreement among respondents that family involvement is essential when rendering EHI services to infants with hearing loss and that the EHI curriculum should be shaped to take into consideration the unique needs and preferences of the family.

- Parents are typically not always informed about relevant support groups for infants with hearing loss.

Man: Multidisciplinary team

- Responding audiologists indicated that they mostly work in a multidisciplinary team.

Method: Regarding the EHI programme

- The results of the survey suggest that no systematic procedures are being used consistently when rendering EHI services to infants with hearing loss.

- Very few audiologists have any system in place to monitor or evaluate the EHI programme.

- Half of the respondents provide rehabilitation services such as auditory, visual and auditory-visual training, the other half refer to members of the multidisciplinary team for provision of these services.

Measurements

- Results reveal that most audiologists do not use the available technology and evidence-based practices for the fitting of appropriate amplification to infants and young children with hearing loss.

- Probe-microphone and electroacoustic measurements, standard prescriptive procedures designed for children, RECD measurements and measurements to verify output limiting of the hearing aids are not used when fitting hearing aids to infants with hearing loss.

- Aided auditory function is typically used as measurement for the fitting of amplification.

Equipment (machine)

- The lack of the necessary equipment was the most frequently cited reason why respondents did not use probe-microphone and electroacoustic measurements, standard prescriptive procedures designed for children and RECD measurements.

Amplification devices (material)

- New-technology hearing aids seem to be the hearing aids of choice for fitting infants with hearing loss.

- Assistive listening devices are seldom fitted to infants with hearing loss.

Mother Nature

- Several factors were highlighted as possible barriers to the rendering of EHI services in South Africa. These were mainly accessibility of health services, financial constraints of the family and the infant/ family support system and to a lesser extent financial constraints of the practice/ clinic/ hospital, cultural diversity and language differences between service provider and family in the provision of EHI services.

5.2.2 Conclusions from Sub-aim two:

To evaluate these EHI services against international professional best practice protocol

There seems to be considerable variability in service quality when compared to international best practice guidelines. Such variability must reflect inequity of provision as well as services not implementing quality standard guidelines. For the most part it seems that the responding audiologists fail to incorporate state-of-the-art technology and evidence-based protocols.

Man: Audiologists

- Respondents indicated that they are trained in many of the areas where international benchmarks require training for EHI services. Yet, respondents indicated a lack of undergraduate training in all areas concerning the selection and fitting of hearing aids for infants with hearing loss.

Man: Infant

- Delays in the rendering of EHI services, fitting of hearing aids and the availability of services, as shown by the results, do not adhere to best practice guidelines and the stated benchmarks. Infants are typically not enrolled into EHI programmes before six months of age and EHI services are not available immediately after confirmation of the hearing loss.

Man: Family

- In accordance with the benchmarks EHI programmes of the respondents are shaped to meet the individualised needs of the infants and their family. EHI and support services seemed to be shaped to meet the individualised needs of the infant and his or her family. Respondents seem to take the family preference for communications mode and their need for comprehensive, documented information into account when rendering these services.

- Respondents' reluctance to supply information about relevant support groups is not in accordance with the international benchmarks.

Man: Multidisciplinary team

- As stated by the international benchmarks, respondents seem to operate in a truly multidisciplinary team with the members that are regarded as essential in the EHI programme.

Method: Regarding the EHI programme

- Contrary to the benchmarks respondents do not evaluate the EHI programmes that they are involved in, nor do they involve parents in this process.

- Most components of the EHI programme, as recommended, do typically form a part of the EHI programme of respondents.

- International guidelines call for rehabilitation services to be included as part of the EHI programme. Respondents were divided, however, with half the respondents performing these services and the other half referring to other team members for these services.

Measurements

- Results indicated that the evidence-based procedures recommended as international best-practice are not used by respondents.

- With regard to the hearing aid selection and evaluation process results revealed that measurements such as electroacoustic and probe-microphone measurements are typically not done as stipulated by the benchmarks.

Equipment (machine)

- In conflict with the international best practice guidelines, respondents do not have the equipment necessary for evidence-based procedures/ measurements.

Amplification devices (material)

- The use of current available technology and safety related features on infant hearing aids (such as tamper resistant battery doors) are in accordance with international best practice guidelines.

- In agreement with the benchmarks, digital sound processing was the technology of choice when selecting hearing aids for infants.

- Not supplying parents with hearing aid kits for the care and maintenance of hearing aids is in conflict with international benchmarks.

Mother Nature

- In harmony with international best practice guidelines respondents shape the EHI curriculum to fit the unique needs of each infant with hearing loss.

These conclusions have several important implications for EHI services in South Africa. In the following section these implications will be highlighted.

5.3 CLINICAL IMPLICATIONS

The results have important clinical implications for the rendering of EHI services to infants with hearing loss in South Africa. An inevitable consequence of the conclusions is that the practice behaviour of South African audiologists needs to change in order to render EHI services of a high quality, aligned with international best practice guidelines to infants with hearing loss.

Improvement of the *training of audiologist* seems to be an obvious way to influence practice behaviour and is echoed in the conclusion from a national survey of educational preparation in paediatric audiology conducted in the USA by Oyler and Matkin (1987: 27-33). It reads: "... to reduce the impact of the hearing loss both upon the family of the hearing-impaired child and upon the child's language acquisition, academic achievement, and ultimately, vocational choices and success, it is apparent that many audiologists need to be better prepared to serve the pediatric population..." (Oyler & Matkin, 1987: 32).

Important subjects were identified during this study, as areas where undergraduate studies need to supply more knowledge to future audiologists. These areas include all aspects of hearing aid selections and fittings. As this is a practical area, practical experience should be incorporated as part of the undergraduate training in these areas. This would supply audiology students with both the expertise and some experience on which they can base their future conduct in the area of paediatric hearing aid fittings. It is acknowledged that the rapidly advancing technology necessitates a strong basic education of the audiologists in conjunction with research. In this regard audiology educational training programmes should change to emphasise evidence-based practice. Audiology students need to become consumers of the evidence in paediatric audiology.

Rehabilitation was identified as an area of EHI where audiologists indicated that they did receive training, yet A/R was not routinely part of the EHI services rendered. In this regard future audiologists, as well as qualified audiologists, need to be informed of the scope of the practice of audiology of which A/R forms part. Audiologists in South Africa need to include A/R as part of the EHI programme in order to serve infants with hearing loss optimally.

Changes in practice can also occur with *continuing education.* Seen in the light of the positive rating that postgraduate training received as a source of knowledge in EHI, continuing education programmes need to be fully utilised. When the content is designed to change specific types of behaviour (Prochaska, 1995 as cited in Bess, 2000: 250) continuing education is most successful. Areas of EHI intervention where services rendered by South African audiologists are not in accordance with international best practice guidelines need to be targeted. As so few audiologists incorporate evidence-based procedures such as RECD or probe-microphone measurements, continuing education programmes with these measurements as focus need to be developed. Continuing education needs to

take into account current technological advances as well as principles of evidence-based practice to realise success. South African audiologists should also be trained in evidence-based principles and practice, in order to evaluate literature in search of "good" evidence.

A very important factor contributing to change practice behaviour is the *development of clinical guidelines or protocols*. Clinical guidelines can supply an important framework for the rendering of EHI services. If South African audiologists engage in an EHI programme grounded in defined benchmarks it makes evaluation of such a programme possible. The programme's inherent ability to be evaluated is also crucial over the long term to sustain and optimise EHI services. To develop good quality EHI and support programmes, a culture of service evaluation is critical. Consistency of service provision should be maximised in pursuit of equity of care. South African quality standards for EHI and support services might alleviate the inequity of service as it may help reduce variation in the provision of EHI services to infants with hearing loss in South Africa. Even though the international guidelines will assist in setting a framework for services to infants with hearing loss in South Africa, it is important to propose guidelines fitting the unique community in South Africa. Several factors influencing EHI services in South Africa were identified and need to be acknowledged when developing a South African protocol for EHI and support services. These factors include the financial implications of proposed procedures, as financial constraints of the family as well as practices or clinics were identified as barriers to service delivery, accessibility of health services especially in rural areas, and finally the lack of infant/ family support system.

The development of *centres of excellence* is a relevant option for the South African context. These centres may serve as examples to other centres in generating relevant research to guide accountable practice in the South African context. It might also be a cost effective way of incorporating evidence-based practice and

state-of-the-art technology. The lack of equipment was identified by this study as a major reason why evidence-based measurements and procedures are not used during the rendering of EHI services in South Africa. The development of centres of excellence seems to be a solution to this problem. Seen in the light of the fact that most respondents indicated that they see five or less infants with hearing loss per year, it might not be financially viable to invest in state-of-the-art equipment. Referring these infants to centres of excellence, where such equipment and expertise can be made available, seems to be a logical solution to this problem. This recommendation is amplified by a statement from The Pediatric Working Group in this regard that urges facilities that lack the expertise or equipment to establish consortial arrangements with those that do (The Pediatric Working Group, 1996: 53). Gravel (2000: 44) echoes this suggestion by stating: "Without current technology or viable agreements between centres, the practice of pediatric audiology should be discontinued." These strong words emphasise the importance of consistent quality services in the rendering of EHI services to infants with hearing loss. Centres of excellence might thus be an effective way to contain costs, yet afford infants the highest quality EHI services.

In this section the important implications and research-based recommendations resulting from the empirical findings were discussed. Similar to the pioneering audiologists who came before, audiologists today can do their part in moving the profession forward (Bess, 2000: 250).

5.4 CRITICAL EVALUATION OF THIS STUDY

A critical evaluation of the study is necessary to justify the conclusions and gain perspectives regarding the implication of the empirical data obtained. The appraisal should reflect both the positive and negative features of the study.

Speculation regarding causative factors and generalisation of the findings of this study to the entire field of audiology should be limited due to the nature of the questionnaire and its results. Audiologists were asked mainly what they do clinically. Only a few questions were designed to ascertain why particular procedures were not being practiced, or why some practices were conducted the way they are. In order to assess the reasoning behind certain results, future surveys would need to be more explicit in assessing individual components of the EHI programme. To incorporate additional subjective information into the current survey would create a very lengthy document and would subsequently reduce the response rate. Even after the questionnaire were changed to incorporate recommendations from the pilot study, some questionnaire items still seemed to be ambiguous (refer to section 4.2.2). More participants in the pilot study could alleviate such problems.

The small sample size makes generalisation of the results to all audiologists difficult and also dictated statistical analysis methods. Some inferences could not be made due to small sample sizes e.g. differences in practice behaviour between audiologists in different working sectors. The fact that most respondents graduated from one tertiary institution also influences the generalisability of the findings, especially findings concerning the training of audiologists.

The significance of this study is that it is the *first study of its kind in South Africa focusing on the nature and scope of EHI services* rendered to infants with hearing loss in South Africa. This study provides baseline information regarding the nature and scope of these services and might serve as the first step towards the development of a South African protocol for EHI and support services to infants with hearing loss in South Africa. To develop good quality EHI and support programmes, a culture of service evaluation is critical (NDCS, 2002: 5). This study *evaluates EHI services* rendered to infants with hearing loss in South Africa in line with the principles of the HSPS of the Professional Board for Speech, Language

and Hearing (HPCSA, 2002a: 1-8), and the Standards of Practice in Audiology (HPCSA, 2002b: 1-4). These documents endorse the evaluation of services to assure quality EHDI programmes and include some suggestions regarding the procedures necessary for the fitting of hearing aids.

This study is also significant as the results from this study might be seen as the first and second steps of a three-step process to improve the quality of EHI services. Quality improvement methods are seen as *class II levels of evidence* (Johnson & Danhauer, 2002:46). Evidence is classified in order to rate the quality thereof. Quality improvement methods, according to Johnson and Danhauer (2002: 50), determine whether clinical services comply with "gold" standards of care, such as preferred practice guidelines. This involves a three-step process of measuring current levels of performance (the aim of this study), establishing means for improvement (the results and conclusion of this study), and then instituting new and better methods of clinical service delivery (an implication of this study).

This study also emphasises the *critical role of the audiologist* in rendering EHI services to infants with hearing loss. Unique knowledge and skills regarding the infant with a hearing loss are necessary and audiologists are uniquely equipped to render these EHI services.

Through this study evidence regarding the practice behaviour of audiologists rendering EHI services to infants with hearing loss in South Africa was added and a necessary first step was taken to afford infants the best possible services as advocated by Bess (2000:250): "If we truly desire to afford the best possible services to children and their families, we must be willing to continually modify our clinical protocols as new evidence emerges."

5.5 RECOMMENDATIONS FOR FUTURE RESEARCH

"The outcome of any serious research can only be to make two questions grow where only one grew before" Thorstein Veblen (1857-1929) (retrieved October 29, 2005, from http://www.quotations.com).

This quotation is also true of the current study. From the answered questions new questions emerged. Recommendations for future research include the following:

- research endeavours specifically focussing on the different components of the EHI programme that might be able to supply more specific information about each aspect, for example the working of the multidisciplinary team;

- research into the effectiveness of the different undergraduate training programmes with regard to all components of the EHI programme;

- evaluation of postgraduate training as well as postgraduate seminars;

- research to develop continuing education programmes relevant for EHI services;

- research endeavours to establish the average age at which infants with hearing loss are fitted with hearing aids in South Africa;

- research to describe the perceptual differences between parents and audiologists in South Africa with regard to parent involvement in the EHI programme;

- research to elucidate the documenting of information to parents, specifically focusing on different kinds of information;

- research into the specific nature of aural rehabilitation and investigation into possible reasons why audiologists rarely supply these services as part of the EHI programme;

- research into the viability of centres of excellence within the South African healthcare system;

- development of a South African protocol for the rendering of EHI and support services to infants with hearing loss;

- continuous evaluation of these services against stated benchmarks once a South African protocol has been developed. This is in line with the Department of Health which motivates that applied research to determine the effectiveness and impact of programmes conducted in South Africa is needed to ensure that all South African citizens are provided with health services that are effective and efficient (Department of Health, 2001: 7).

5.6 CLOSING STATEMENT

Only the implementation of evidence-based EHI services can lead us to the highest quality service provision for infants and young children with hearing loss and their families (Bess, 2000 in Gravel, 2005: 24). The need to improve the quality of life of infants with hearing loss and free the potential of each child, as dictated by our constitution (1996, as cited by SAHRC, 2002: 24), is their right, not their privilege, and above all: Our responsibility.

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APPENDIX A

COVER LETTER (ENGLISH AND AFRIKAANS) AND QUESTIONNAIRE

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

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Departement Kommunikasiepatologie
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13 Augustus 2004,

Beste Oudioloog,

Met 'n wêreldwye beweging na neonatale gehoorsifting word goeie, akkurate en familie vriendelike vroeë intervensie gehoordienste al hoe meer noodsaaklik. Die eiesoortige Suid Afrikaanse konteks bring unieke uitdagings aan die Suid Afrikaanse pediatriese oudioloog. Die ideal is om intervensie en ondersteuningsdienste van hoë kwaliteit aan babas (0 tot 3 jaar) met gehoorverlies te bied. Ten einde hierdie doel te bereik behoort die aard en omvang van huidige intervensie en ondersteuningsdienste deur die Suid Afrikaanse oudioloë eers beskryf te word.

As deel van die vereistes van die graad M.Kommunikasiepatologie is ek tans besig met 'n navorsingsprojek. Die doel van hierdie navorsingsprojek is om die aard en omvang van vroeë intervensie dienste, wat volg op die diagnose van gehoorverlies by die pediatriese populasie, deur Suid Afrikaanse oudioloë te beskryf.

Deur hierdie vraelys te voltooi kan u belangrike inligting verskaf wat kan help om uiteindelik die bes-moontlike dienslewering aan Suid Afrikaanse babas met gehoorverlies te verseker.

As gevolg van meeste internasionale terme en begrippe wat algemeen in Engels gebruik word is die vraelys in Engels opgestel. Indien daar egter enige probleme of vrae as gevolg daarvan ontstaan kan u my gerus per e-pos verwittig en ek kan dit in Afrikaans beskikbaar maak. Die vraelys word anoniem voltooi. Soos telefonies met u bespreek kan u die vraelys weer aan my terug e-pos. Die vraelys word nadat ek dit ontvang het uitgedruk en die e-pos adres uitgewis om u anonimiteit te verseker. Resultate van die studie kan moontlik in die toekoms vir opleiding, publikasie ens gebruik word. U **eerlike mening en akkurate inligting** word hoog op prys gestel.

Ek bedank u hartlik vir die moeite en tyd om hierdie vraelys te voltooi.

Nogmaals dankie, vriendelike groete
Susan Strauss (M. Kommunikasiepatologie student)
susanstrauss@classicmail.co.za Studie leiers: Dr M Soer/ Mrs L Pottas
Hoof van die department: Prof B Louw

Ingeligte toestemming: Hiermee verklaar ek dat ek bewus is daarvan dat resultate moontlik in die toekoms vir opleiding ens gebruik kan word. Ek verstaan dat my konfidensialiteit gewaarborg word.
Handtekening:_____ Datum:_____

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

University of Pretoria

Department of Communication Pathology
Speech, Voice and Hearing Clinic
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Questionnaire follows on the next page
13 August 2004,

Dear Audiologist,

With a worldwide movement towards universal newborn hearing screening the need to ensure good, accurate, family friendly hearing services becomes more critical. The unique South African context brings unique challenges to the South African paediatric audiologist. By describing the scope and nature of these services by South African audiologists, the first step can be taken towards ensuring high quality intervention and support services to infants with hearing loss in South Africa.

As part of my M. Communication pathology studies at the University of Pretoria I am conducting a research project. This research project aims to determine the nature and scope of intervention and support services, following diagnosis of hearing loss, to the paediatric population by South African Audiologists. The information will be used to propose a protocol for South African intervention and support services to the paediatric population.

By completing the following questionnaire you can provide important information to help ensure the best possible service to South African hearing impaired infants.

The questionnaire will be completed anonymously. Once received, the questionnaire will be printed out, and your e-mail address deleted to insure you anonymity. Results obtained through this study might be used in future for training purposes, publication etc. Your honest information and opinions will be highly appreciated. I sincerely thank you for your effort and time. Please attach the completed questionnaire and e-mail it back to me: susanstrauss@classicmail.co.za. You can also fax it to 012-991 4993.

Kind regards
Susan Strauss (M. Communication pathology student)
Study leaders: Dr M Soer/ Mrs L Pottas
HEAD OF THE DEPARTMENT: Prof B Louw

Consent: Please sign to confirm that you are aware that results of the study might be used for future training or other purposes. Your confidentiality is guaranteed.

Signature of respondent:_____ Date:_____

Questionnaire:

For office use only

V1 [ ][ ][ ] 1-3

Respondent number

1 Did you qualify as a…(please mark the one applicable)

Speech- Language Pathologist and Audiologist	1		
Audiologist only?	2		V2 [ ] 4

2 What year did you qualify as the above?

[ ][ ][ ][ ] V3 5-8

3 At what university did you complete your undergraduate studies?

[ ] V4 9

4 Please indicate which sector/s you work in (max of 2 sectors)

Private Practice	1		V5 [ ] 10
University/ Educational Centre	2		V6 [ ] 11
School for Hearing Impaired Children	3		
Government Hospital/ Clinic	4		
Private Hospital	5		
Hearing Aid Company	6		
Other (please specify)	7		

5 Please mark the areas of Early Hearing Intervention(EHI) (infants 0-3 years) that you received undergraduate training in:

Visual communication training	1		V7 [ ] 12
Auditory communication training	2		V8 [ ] 13
Perform paediatric hearing aid fittings	3		V9 [ ] 14
Monitor paediatric hearing aid fittings	4		V10 [ ] 15
Describe, perform and interpret behavioural measures of performance with hearing aids	5		V11 [ ] 16
Perform and interpret measures of electro-acoustic characteristics of hearing aids	6		V12 [ ] 17
Perform and interpret measures of electro-acoustic characteristics of assistive devices	7		V13 [ ] 18
Paediatric hearing aid selection procedures	8		V14 [ ] 19
Providing accurate and unbiased information	9		V15 [ ] 20
Counselling skills	0		V16 [ ] 21
Working in partnership with parents to form a family-centred EHI program	1		V17 [ ] 22
Speech and language assessment procedures	2		V18 [ ] 23
Paediatric audiologic assessment procedures (infants 0- 3 years)	3		V19 [ ] 24
Effects of hearing impairment on language and communication development on the child	14		V20 [ ] 25
Early childhood development	5		V21 [ ] 26
Working in partnership with other professionals	6		V22 [ ] 27

6 In the area of Early Hearing Intervention, where did you receive most of your training/ knowledge? Please rate the significance of the following as a source of knowledge/ training. 1= Very significant, 2= Significant, 3= Not significant, N/A= Not Applicable

Under-graduate studies	1	2	3	N/A	V23	28
Post graduate studies	1	2	3	N/A	V24	29
Post graduate seminars	1	2	3	N/A	V25	30
Literature	1	2	3	N/A	V26	31
Knowledge sharing with colleagues	1	2	3	N/A	V27	32

7 Please indicate the years experience you have in the intervention of and support services to infants (0-3 years) with hearing loss

	V28	33-34

8 Mark the specific components that usually form part of the EHI program that you are **currently** engaged in

Developing an individualized family service plan (incorporating the family's preferences for outcomes)	1		V29	35
Selection of amplification	2		V30	36
Fitting of amplification	3		V31	37
Selection of assistive technology	4		V32	38
Fitting of assistive technology	5		V33	39
Verification of the fitting	6		V34	40
Ongoing monitoring of the fitting	7		V35	41
Family education and counselling	8		V36	42
Participate in the assessment for candidacy for cochlear implantation	9		V37	43
Provision of direct auditory rehabilitation services (e.g. auditory and speech training)	10		V38	44
Working in a multidisciplinary team	11		V39	45
Ongoing audiologic monitoring for infants with amplification	12		V40	46

9 How many infants between 0 and 3 years diagnosed with permanent bilateral hearing loss (25dB or more in the 500Hz through 4000Hz region) do you enrol in an EHI program on average per year?

	V41	47-48

10 Indicate the percentage of these infants (0 – 3 years) (refer **question 8**), in the EHI program that you are involved in, where hearing loss are diagnosed:

Before 6 months old:	%	6-12 months:	%	V42	49-51
12- 24 months:	%	24-36 months:	%	V43	52-54
				V44	55-57
				V45	58-60

11 If you work in a multidisciplinary EHI team, mark the team members usually involved in the team

Paediatrician	1		The child	7		V46		V47		61-62
The parents	2		Ear- Nose &Throat Specialist	8		V48		V49		63-64
Speech Language Pathologist	3		Occupational Therapist	9		V50		V51		65-66
Social Worker	4		Other Parents	10		V52		V53		67-68
General Practitioner	5		Others (specify)	11		V54		V55		69-70
Day care teacher/ educator	6					V56				71

12 Rate the involvement of the parents in the following areas of the EHI program that you are involved in(1= Always involved, 2= Frequently involved, 3= Seldom involved, 4= Never involved)

Deciding on the modes of communication of the infant	1	2	3	4	V57	72
Deciding on the support and intervention of the child	1	2	3	4	V58	73
Monitoring the effectiveness of the EHI program	1	2	3	4	V59	74
Self- advocacy (active support of and pleading for the infant)	1	2	3	4	V60	75

13 How often do you supply parents with the following:
(1=Always, 2= Frequently, 3= Seldom, 4= Never)

Copies of the audiogram	1	2	3	4	V61	76
Other audiologic assessments with full explanation	1	2	3	4	V62	77
Information about the full range of resources in EHI	1	2	3	4	V63	78
Information about the education programs/ options	1	2	3	4	V64	79
Information about the different communication modes available	1	2	3	4	V65	80
Information about the relevant support groups/ charities	1	2	3	4	V66	81

14 How often do you document the information given to the parents (1=Always, 2= Frequently, 3= Seldom, 4= Never)

1	2	3	4	V67		82

15 Indicate the usual time delay between the confirmation of the hearing loss and the availability of EHI services to the infants (0-3 years)in the EHI program you are involved in. Mark the one applicable.

Available immediately	1		Available in the first week	2		V68		83
Available in the first month	3		Available after a month	4				

16 Do you use a set protocol/ EHI program for all children with hearing loss (including communication mode)?

yes	no	V69		84

Do you shape the EHI curriculum to the infant and family profile?

yes	no	V70		85

17 Indicate the frequency with which the following factors play a role in your service delivery to infants (0- 3 years) and their families
(1=Always, 2= Frequently, 3=Seldom, 4= Never)

Geographic aspects (e.g. accessibility of health service)	1	2	3	4	V71		86
Climate (e.g. moist, hearing aid breakage as a result)	1	2	3	4	V72		87
Financial constraints of the family	1	2	3	4	V73		88
Financial constraints of the practice/ clinic/ hospital etc	1	2	3	4	V74		89
Cultural diversity (e.g. how disability is viewed by the culture)	1	2	3	4	V75		90
Language differences between the service providers and family	1	2	3	4	V76		91
Lack of language interpreters	1	2	3	4	V77		92
Absence / inadequacy of deaf role models	1	2	3	4	V78		93
Educational levels of the family or caregivers	1	2	3	4	V79		94
Religious diversity	1	2	3	4	V80		95
Infant/ Family support system	1	2	3	4	V81		96

Could you identify any additional factors influencing the EHI service?
(list if applicable)

	1	2	3	4	V82		97
	1	2	3	4	V83		98

18 Indicate the usual time delay between the confirmation of the hearing loss and the fitting of infants with amplification in the EHI program that you are involved in

Within the first month	1		Between 1 and 3 months	2			
Between 3 and 6 months	3		Longer than 6 months	4		V84	99

19 Do you usually fit infants with permanent bilateral hearing loss with two hearing aids?
1=Always, 2=Frequently, 3=Seldom, 4= Never

	1	2	3	4	V85		100

20 If you marked **3 or 4** at **question 19**, please supply reasons:

	V86		101

21 Which of the following measurements do you usually perform when fitting amplification to infants? (mark where applicable)

Aided sound field response measurements	1		V87		102
Probe microphone measurements	2		V88		103
Black box testing	3		V89		104
Measuring the amount of gain the hearing aids provide	4		V90		105
Measurements to verify output limiting	5		V91		106
Shaping the frequency response	6		V92		107
Real Ear to Coupler Difference (RECD)	7		V93		108

22 If you **do not** use probe microphone measurements, please indicate the reason/ reasons why not, **then proceed to question 24**

I do not believe it is possible to perform probe microphone measurements on infants under 3 years	1		V94	109
I do not have enough time to do it	2		V95	110
I do not have the necessary equipment to do these measurements	3		V96	111
I do not have the experience to do these measurements	4		V97	112
I do not have the knowledge to do these measurements	5		V98	113
Other reasons, please indicate	6		V99	114

23 If **you do use probe microphone measurements** please mark the following:

For linear hearing instruments do you use a 60dB swept pure tone/ speech weighted noise? yes | No — V100 — 115

If not, please describe what you use:

V101 — 116

For non-linear hearing instruments do you use multiple signal levels? Yes | No — V102 — 117

If not, please describe what you use:

V103 — 118

24 Do you usually preset the hearing aids in a hearing aid test box? Yes | No — V104 — 119

25 If you answered **yes** to **question 24**, please indicate which values you usually use to preset the hearing instruments in the test box: (choose one). (If you answered **no** to **question 24** proceed to **question 26**).

Coupler values as indicated by the hearing aid software or specification (spec) sheet:	1		V105	120
Published or measured Real Ear to Coupler Difference (RECD) values	2			
Other, please specify.	3			

26 Do you use standard prescriptive procedures designed for children (e.g. Desired Sensation Level (DSL) (Seewald, 1992)) when selecting values for frequency/ output limiting characteristics? Yes | No — V106 — 121

27 If you answered **no** to **question 26** please mark the possible reason/s why not. (If you answered **yes** to **question 26**, proceed to **question 28**)

I do not have the necessary equipment/ software to use these procedures	1		V107	122
I do not believe there is a difference between normal prescriptive procedures (e.g. NAL, ½ Gain rule etc) and procedures designed for children	2		V108	123
I do not have enough time	3		V109	124
I do not have the experience to do it	4		V110	125
I do not know what DSL is	5		V111	126
Other reasons please specify.	6		V112	127

28 Please mark one of the following regarding aided sound field response measurements:

I never use sound field response measurements when fitting amplification to infants	1		V113	128
I use sound field response measurements to fit amplification to infants (verification of frequency and gain response)	2			
I use sound field response measurements to validate aided auditory function when fitting infants with amplification	3			
Other applications. Please specify.	4			

29 Please mark all the feature/s that you regard as essential when fitting infants with hearing aids:

Direct audio input	1		Telecoil switch	2		V114	V115	129-0
Tamper resistant volume control	3		Microphone-telecoil switch	4		V116	V117	131-2
Tamper resistant battery compartment	5		Others, please specify	6		V118	V119	133-4

30 When fitting infants (0-3 years) with amplification, how frequently do you fit or use the following:
(1=Always, 2=Frequently, 3=Seldom, 4=Never)

Digital hearing aids	1	2	3	4	V120	135
Digitally programmable analogue hearing aids	1	2	3	4	V121	136
Linear analogue hearing aids	1	2	3	4	V122	137
Non-linear analogue hearing aids	1	2	3	4	V123	138
Behind the ear hearing aids (BTE)	1	2	3	4	V124	139
In the ear/ canal hearing aids (ITC/ ITE)	1	2	3	4	V125	140
Completely in the canal hearing aids (CIC)	1	2	3	4	V126	141
Body worn hearing aids	1	2	3	4	V127	142
Bone conduction type hearing aids	1	2	3	4	V128	143

30 **Question 30 continue:** With infants (0-3 years), how frequently do you fit the following: (1=Always, 2= Frequently, 3=Seldom, 4= Never)

Hearing aids with omni-directional microphones	1	2	3	4	V129			144
Hearing aids with directional microphones	1	2	3	4	V130			145
Hearing aids with adaptive microphones (omni & or directional)	1	2	3	4	V131			146
Assistive listening devices (e.g. FM systems)	1	2	3	4	V132			147
Soft ear moulds (silicon)	1	2	3	4	V133			148
Hard ear moulds (acrylic)	1	2	3	4	V134			149
Parent/ teacher hearing aid kit with a stetoclip, air puffer etc.	1	2	3	4	V135			150

31 How often do you usually monitor the audiologic findings of the newly diagnosed infant fitted with amplification? (Mark one)

Every 3 months	1		Every 6 months	2		V136		151
Once a year	3		Less than once a year	4				

32 How often do you usually review the hearing aid fitting for newly diagnosed infants fitted with amplification? (Mark one)

Weekly	1		Monthly	2		V137		152
Every 3 months	3		Every 6 months	4				
Once a year	5		Less than once a year	6				

33 Please mark the aspect/ s that you usually include in the follow-up visits with infants fitted with hearing aids:

Behavioural audiometric evaluations	1		V138		153
Assessment of communication abilities, needs and demands	2		V139		154
Adjustments of the amplification system based on updated audiometric information and communication demands	3		V140		155
Periodic electro-acoustic evaluations	4		V141		156
Listening checks	5		V142		157
Ear mould fit checks	6		V143		158
Periodic probe-microphone measurements	7		V144		159
Periodic functional measures to document development of auditory skills	8		V145		160
Long-term follow-up (through interdisciplinary evaluations) including academic progress	9		V146		161
Anything else please specify	10		V147		162

34 Regarding specific auditory rehabilitation services, indicate the following:

1= As an audiologist I provide this service

2= I do not provide this service personally, but refer to a member of the multi-disciplinary team for this service

3= I am not involved nor do I refer the infant to anyone for this specific service

1	Visual training (e.g. speech reading)	1	2	3	V148			163
2	Auditory training	1	2	3	V149			164
3	Auditory-visual training	1	2	3	V150			165
4	A complete language evaluation	1	2	3	V151			166

35 If you marked **option 3** at any of the options at **question 34** please supply reason/s at the corresponding numbers below:

1		V152		167
2		V153		168
3		V154		169
4		V155		170

36 Do you have a system of evaluating each component of the EHI program that you are currently involved in?

Yes	No			
		V156		171

37 If you answered **yes** to **question 36**, please describe your evaluation system:

	V157		172

APPENDIX B

ETHICAL CLEARANCE FROM THE RESEARCH PROPOSAL AND ETHICS COMMITTEE AND TITLE REGISTRATION

University of Pretoria

Research Proposal and Ethics Committee
Faculty of Humanities

4 August 2004

Dear Mrs Pottas

Project:	***Early hearing intervention and support services provided to the paediatric population by South African audiologists***
Researcher:	**S Strauss**
Supervisor:	**L Pottas**
Department:	**Communication Pathology**
Reference number:	**91083860**

Thank you for the application and excellent proposal you submitted to the Research Proposal and Ethics Committee, Faculty of Humanities.

I have pleasure in informing you that the Research Proposal and Ethics Committee formally approved the above study on 22 July 2004.

The committee requests you to convey this approval to Ms Strauss.

We wish you success with the project.

Sincerely

B Louw

Prof Brenda Louw
Chair: Research Proposal and Ethics Committee
Faculty of Humanities
UNIVERSITY OF PRETORIA

APPENDIX C

ADDITIONAL INFORMATION FOR CHAPTER FOUR

Table 1: Undergraduate training in the specific areas of Early Hearing Intervention.

Area of Early Hearing Intervention	**Did receive training in**		**Did not receive training in**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
1 Visual communication training	21	52.5%	19	47.5%
2 Auditory communication training	29	72.5%	11	27.5%
3 Perform paediatric hearing aid fittings	17	42.5%	23	57.5%
4 Monitor paediatric hearing aid fittings	14	35%	26	65%
5 Describe, perform and interpret behavioural measures of performance with hearing aids	14	35%	26	65%
6 Perform and interpret measures of electro-acoustic characteristics of hearing aids	13	32.5%	27	67.5%
7 Perform and interpret measures of electro-acoustic characteristics of assistive devices	2	5%	38	95%
8 Paediatric hearing aid selection procedures	15	37.5%	25	62.5%
9 Providing accurate and unbiased information	23	57.5%	17	42.5%
10 Counseling skills	33	82.5%	7	17.5%
11 Working in partnership with parents to form a family-centred EHI program	24	60%	16	40%
12 Speech and language assessment procedures	36	90%	4	10%
13 Paediatric audiologic assessment procedures (infants 0- 3 years)	38	95%	2	5%
14 Effects of hearing impairment on language and communication development on the child	40	100%	0	0%
15 Early childhood development	40	100%	0	0%
16 Working in partnership with other professionals	34	85%	6	15%

Table 2: The performance of paediatric hearing aid fittings versus the year of graduation:

Frequency Percentage Row Percentage Column Percentage	Post 2001	Pre 2001	Total
NO	4 10.00% 17.39% 33.33%	19 47.5% 82.61% 67.86%	23 57.5%
YES	8 20.00% 47.06% 66.67%	9 22.5% 52.94% 32.14%	17 42.50%
TOTAL	12 30.00%	28 70.00%	40 100.00%

Table 3: The monitoring of paediatric hearing aid fittings versus year of graduation:

Frequency Percentage Row Percentage Column Percentage	Post 2001	Pre 2001	Total
NO	5 12.5% 19.23% 41.67%	21 52.5% 80.77% 75%	26 65.00%
YES	7 17.5% 50.00% 58.33%	7 17.5% 50.00% 25.00%	14 35.00%
TOTAL	12 30.00%	28 70%	40 100%

Table 4: Speech and language assessment procedures versus year of graduation:

Frequency Percentage Row Percentage Column Percentage	Post 2001	Pre 2001	Total
NO	4 10% 100% 33.33%	0 0% 0% 0%	4 10%
YES	8 20% 22.22% 66.67%	28 70% 77.78% 100%	36 90%
TOTAL	12 30%	28 70%	40 100%

Table 5: Results of question 6 summarised, frequencies and percentages

	Very significant		Significant		Not significant		Not applicable	
Undergraduate studies	13	32.5%	17	42.5%	10	25%	0	0%
Post graduate studies	11	28.21%	4	10.26%	3	7.69%	21	53.85%
Post graduate seminars	26	65%	9	22.5%	1	2.5%	4	10%
Literature	18	46.15%	18	46.15%	2	5.13%	1	2.56%
Knowledge sharing with colleagues	24	61.54%	13	33.33%	2	5.13%	0	0%

Table 6: Mean values

Knowledge source	Mean	Rating of significance
Undergraduate studies	1.9250000	5
Post graduate studies	1.5555556	3
Post graduate seminars	1.3055556	1
Literature	1.5789474	4
Knowledge sharing with colleagues	1.4358974	2

Table 7: The participants' years of experience in EHI.

Years experience in EHI	Number of participants	Percentage
0	2	5%
1	7	17.5%
2	3	7%
3	5	12.5%
4	4	10%
5	1	2.5%
6	2	5%
7	1	2.5%
8	1	2.5%
9	2	5%
10	3	7.5%
11	1	2.5%
13	1	2.5%
14	1	2.5%
17	1	2.5%
20	3	7.5%
21	1	2.5%
23	1	2.5%

Table 8: The significance of undergraduate studies as a source of knowledge in EHI and the years' experience of the participants in EHI.

Frequency Percentage Row Percentage Column Percentage	0-5 years' experience	6-10 years' experience	10 years' + experience	Total
Very Significant	9 22.5% 69.23% 40.91%	2 5% 15.38% 22.22%	2 5% 15.38% 22.22%	13 32.5%
Significant	10 25% 58.82% 45.45%	4 10% 23.53% 44.44%	3 7.5% 17.65% 33.33%	17 42.5%
Not Significant	3 7.5% 30% 13.64%	3 7.5% 30% 33.33%	4 10% 40% 44.44%	10 25%
Total	22 55%	9 22.5%	9 22.5%	40 100%

Table 9: Significance of postgraduate studies versus years experience in EHI

Frequency Percentage Row Percentage Column Percentage	0-5 years' experience	6-10 years' experience	10 years' + experience	Total
Very Significant	6 15.38% 54.55% 27.27%	1 2.56% 9.09% 11.11%	4 10.26% 36.36% 50%	11 28.21%
Significant	3 7.69% 75% 13.64%	1 2.56% 25% 11.11%	0 0% 0% 0%	3 7.69%
Not Significant	0 0% 0% 0%	3 7.69% 100% 33.33%	0 0% 0% 0%	3 7.69%
Not Applicable	13 33.33% 61.9% 59.09%	4 10.26% 19.05% 44.44%	4 10.26% 19.05% 50%	21 53.85%
Total	22 56.41%	9 23.08%	8 20.51%	39 100%

Table 10: Significance of postgraduate seminars as a source of knowledge in EHI versus years experience in EHI

Frequency Percentage Row Percentage Column Percentage	0-5 years' experience	6-10 years' experience	10 years' + experience	Total
Very Significant	14 35% 53.85% 63.64%	6 15% 23.08% 66.67%	6 15% 23.08% 66.67%	26 65%
Significant	5 12.5% 55.56% 22.73%	2 5% 22.22% 22.22%	2 5% 22.22% 22.22%	9 22.5%
Not Significant	1 2.5% 100% 4.55%	0 0% 0% 0%	0 0% 0% 0%	1 2.5%
Not Applicable	2 5% 50% 9.09%	1 2.5% 25% 11.11%	1 2.5% 25% 11.11%	4 10%
Total	22 55%	9 22.5%	9 22.5%	40 100%

Table 11: Significance of literature as a source of knowledge in EHI versus years experience in EHI

Frequency Percentage Row Percentage Column Percentage	0-5 years' experience	6-10 years' experience	10 years' + experience	Total
Very Significant	9 23.08% 50% 40.91%	6 15% 33.33% 66.67%	3 7.69% 16.67% 37.5%	18 46.15%
Significant	10 25.64% 55.56% 45.45%	3 7.69% 16.67% 33.33%	5 12.82% 27.78% 62.5%	18 46.15%
Not Significant	2 5.13% 100% 9.09%	0 0% 0% 0%	0 0% 0% 0%	2 5.13%
Not Applicable	1 2.56% 100% 4.55%	0 0% 0% 0%	0 0% 0% 0%	1 2.56%
Total	22 56.41%	9 23.08%	8 20.51%	39 100%

Table 12: Significance of knowledge sharing with colleagues as a source of knowledge in EHI versus years experience in EHI

Frequency Percentage Row Percentage Column Percentage	0-5 years' experience	6-10 years' experience	10 years' + experience	Total
Very Significant	15 38.46% 62.5% 68.18%	5 12.82% 20.83% 55.56%	4 10.26% 16.67% 50%	24 61.54%
Significant	7 17.95% 53.85% 31.82%	2 5.13% 15.38% 22.22%	4 10.26% 30.77% 50%	13 33.33%
Not Significant	0 0% 0% 0%	2 5.13% 100% 22.22%	0 0% 0% 0%	2 5.13%
Total	22 56.41%	9 23.08%	8 20.51%	39 100%