The Health Professions Council of South Africa

PROFESSIONAL BOARD FOR SPEECH, LANGUAGE AND HEARING PROFESSIONS

EARLY HEARING DETECTION AND INTERVENTION (EHDI)

GUIDELINES

YEAR 2018

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LIST OF ABBREVIATIONS

AABR:	Automated Auditory Brainstem Response
AAP:	American Academy of Pediatrics
ASSR	Auditory Steady State Response
ECMO:	Extracorporeal Membrane Oxygen
EHDI:	Early Hearing Detection and Intervention
HIV:	Human Immunodeficiency Virus
IEC:	Information, Education and Counselling (IEC) Resources
JCIH:	Joint Committee on Infant Hearing (an American committee)
KMC:	Kangaroo Mother Care
NHS:	Newborn Hearing Screening
NICU:	Neonatal Intensive Care Unit
OAE:	Otoacoustic emission
PCEHL:	Permanent Congenital and Early-onset Hearing Loss
PHC:	Primary Health Care
UNICEF:	United Nations International Children's Emergency Fund
UNIHS:	Universal Newborn and Infant Hearing Screening
UNS:	Universal Newborn Screening
WHO:	World Health Organisation

I. PREAMBLE

The Professional Board for Speech, Language and Hearing Professions of the Health Professions Council of South Africa sets out the following position regarding Early Hearing Detection and Intervention (EHDI) programmes in South Africa.

The Professional Board's Year 2018 Position Statement is a revision of the Professional Board's Year 2007 Position Statement on Newborn and Infant Hearing Screening and the subsequent follow-up and intervention process. It encompasses and recognises the following as the definitive guiding documents for EHDI:

- The Joint Committee for Infant Hearing (JCIH) Year 2007 Position Statement
- The 2007 Clarification of Year 2007 JCIH Position Statement
- Supplement to the JCIH 2007 Position Statement: Principles and Guidelines for Early Intervention After Confirmation That a Child is Deaf or Hard of hearing
- The American Academy of Pediatrics (AAP) 1999 statement on Newborn and Infant Hearing Loss
- World Health Organisation 2010 Newborn and Infant Hearing Screening: Current Issues and Guiding Principles for Action

These documents have therefore served to guide the updated formulation of an EHDI framework for South Africa within the unique contextual characteristics of the country. Therefore, a critical consideration of international benchmarks was necessary in light of research from South Africa and other developing countries towards the compilation of a contextually relevant position statement.

II. RATIONALE

The Mission of the Health Professions Council of SA and its Professional Boards is to guide professionals and protect the public. This places a responsibility on the Professional Boards to ensure that excellent standards are achieved in service delivery to patients.

EHDI programmes, as proposed in this position statement, are recommended to identify, diagnose and implement management plans for newborns and infants with disabling hearing loss as early as possible. The aim is to ensure optimum and cost effective solutions that enable persons to communicate effectively. This intervention allows them to develop to their maximum potential, and thereby secure their full participation in, and contribution to society and the country's economy.

This initiative is grounded on the principle that an improvement in early childhood development is central to more equal opportunities (World Bank, 2005; WHO, 2012). As stated in the 2006 World Development Report, *'Evidence supports the view that investing in early childhood has large impacts on children's health and readiness to learn and can bring important economic returns later in life—often greater than investments in formal education and training.'* (World Bank, 2005). Since differences in cognitive development start to widen from a very early age, early childhood development initiatives are central to create more equal opportunities (World Bank, 2005; Department of Social Development, 2006). This is even more pronounced in the case of children born with a disability such as childhood hearing loss. Numerous studies have demonstrated the cognitive, social-emotional, vocational and financial constraints on their development compared to those without the disability (Moeller, 2000; World Bank, 2005; Yoshinaga-Itano et al. 1998; UNICEF, 2013). Effective EHDI programmes, in contrast have demonstrated the ability to address the inequalities caused by the developmental constraints associated with infant hearing loss (Kennedy et al. 2005; Yoshinaga-Itano, 2004; Ching et al., 2013). Children in such programmes are afforded the opportunities to develop to their maximum potential, allowing them to become participating and contributing members of their communities. Comprehensive and integrated EHDI programmes are therefore accepted and proposed as the standard of care for service-delivery to newborns and infants with hearing loss.

III. THE POSITION STATEMENT

The Professional Board for Speech, Language and Hearing Professions of the Health Professions Council of South Africa advocates early detection of and intervention for, infants with hearing loss (EHDI programmes) through integrated Provincial and District service delivery mechanisms which include all relevant government, private and non-governmental organisation (NGO) role players. This must be attained by inter-sectoral collaboration with governmental departments at all levels of care, including health, social development and education, and the private sector (Department of Social Development, 2006; Gauteng Provincial Speech Therapy & Audiology Levels of Service Delivery Workgroup & HPCSA Board for Speech-Language & Hearing Professions, 2014). The goal of EHDI is to provide children with hearing loss optimal and timely opportunities to develop linguistic, literary and communicative competence in keeping with their full potential. The adverse effects of hearing loss on language and cognitive development, as well as on psychosocial behaviour are widely reported against the established and dramatic benefits of early intervention (Kennedy et al., 2005; Yoshinaga-Itano, 2004; Mason & Mason, 2007; Pimperton & Kennedy, 2012).

Research evidence indicates that an infant with hearing impairment who receives early intervention within the first six months of life is likely to have linguistic, speech, and cognitive development comparable to normal hearing peers in contrast to persistent delays for those who are identified late (Kennedy et al., 2005; Yoshinaga-Itano 2004; Ching et al., 2013). Factors predictive of outcomes include: age of fitting of amplification, parental education and involvement, service delivery models, quality of intervention services and comorbid conditions (Ching et al, 2013; Pimperton & Kennedy, 2012; Wake et al., 2005; Fitzpatrick et al., 2007; Korver et al, 2010; Khoza-Shangase & Harbinson, 2015)

Universal screening programmes for hearing loss indicate long term economic benefits in terms of reduced costs for specialised education, social welfare and improved lifetime productivity for individuals with hearing loss (Yoshinaga-Itano & Gravel, 2001). Universal newborn and infant hearing screening (UNIHS) is therefore recommended as the preferred option for public and private health care (JCIH, 2007; Olusanya, Luxon & Wirz, 2005).

UNIHS is recommended using objective physiologic measures to identify congenital and early onset hearing loss. Even though initial savings may be substantial by following a risk-based screening approach, the long-term economic benefits of early identification of hearing loss will be severely compromised if a universal screening model is not applied (Yoshinaga-Itano & Gravel, 2001; Yoshinaga-Itano, 2004). The international gold standard is for EHDI programmes to reach the 1-3-6 principle – screening for hearing loss by 1 month of age, diagnosing hearing loss by 3 months of age and for intervention to commence by 6 months of age (JCIH, 2007). Contextualising this for South Africa where majority of babies will not be screened in hospital-based programmes, the following timeframes are suggested:

- Initial hearing screening should take place before 1 month of age and by no later than 6 weeks of age for programmes linked to immunisation visits
- Diagnostic audiological and, if necessary, medical evaluations should be in progress **before 3 months of age** and diagnosis confirmed by **no later than 4 months of age**.
- Infants with confirmed hearing loss should receive **intervention before 6 months of age and no later than 8 months of age** from health care professionals and early interventionists with experience in infant hearing loss.
- Infants passing their initial hearing screening, but **demonstrating risk indicators for delayed onset or progressive hearing loss** must receive **ongoing monitoring by caregivers** and **primary care providers**. They must be informed of the risks and ensure that they track the communication development milestones. **Audiological monitoring** protocols should be developed according to the latest evidence (see VII, section D).
- All caregivers and/or primary care providers should be encouraged to monitor children's communication development milestones and to flag any concerns immediately.

- EHDI systems must facilitate and manage this process to ensure infants and their families will have efficient and timely access to the proposed services from the initial screening through to diagnosis and early intervention.

The early intervention programmes following diagnosis of hearing loss must be family-centred within a community-based model of service delivery that is culturally congruent (Louw & Avenant, 2002; Swanepoel, Hugo & Louw, 2006; Sass-Lehrer, 2014). Professional involvement should be within an inter-professional team in which families assume an equal partner role based on informed choice. The goal of informed choice is to ensure that the family's decision to accept or decline the hearing screening and subsequent services stems from an understanding of the consequences of each course of action (Olusanya, Luxon & Wirz, 2004a). Comprehensive and unbiased information from professional, educational and consumer organisations should therefore be provided to allow families to make informed choices. The responsibility and accountability for outcomes of EHDI programmes must be instituted at all levels of health care integrated with early childhood development initiatives by the Departments of Social Development and Education to provide an ongoing measurement of EHDI status and development.

IV. BACKGROUND

Impact of infant hearing loss and benefits of EHDI

Hearing loss is referred to as the silent, overlooked epidemic of developing countries because of its invisible nature which prevents detection through routine clinical procedures (Swanepoel, Hugo & Louw, 2005a). It is referred to as an epidemic because of its high prevalence and its being the most frequently occurring birth defect. Even though hearing loss may not be a life-threatening condition, failure to intervene in time renders it a severe threat to critical quality of life indicators (Mehl & Thomson, 1998; Olusanya, Luxon & Wirz, 2004b; Swanepoel, Delport & Swart, 2004). Neurobiology has revealed a 'critical window' for the process of developing a functional auditory system after which, if appropriate stimulation is withheld, cross-modal cortical reorganisation takes place. This can lead to deficits in processing multimodal stimulation that is necessary for language learning (Sharma, Nash & Dorman, 2009). The adverse effects of hearing loss on language and cognitive development, as well as on psychosocial behaviour are widely reported against the established benefits of early intervention. In addition to this a society is also severely burdened by hearing loss due to the extensive economic costs associated with it. Hearing loss without adequate intervention affects an individual's ability to obtain, perform in and keep a job, and it causes people to be isolated and stigmatised during the entire course of their lives (Moeller 2000; Yoshinaga-Itano, 2004). The income of individuals with hearing loss is reported to be 40 to 45% less than the hearing population in developed countries and will be even more pronounced in developing countries like South Africa, rendering those with hearing loss the poorest of the poor (Olusanya, Ruben & Parving, 2006).

This stands in stark contrast to the body of current evidence which indicates the benefits of Universal Newborn and Infant Hearing Screening (UNIHS) programmes that have demonstrated earlier detection of hearing loss. This early identification of hearing loss coupled with subsequent early intervention has led to linguistic, speech and cognitive development that is comparable to normal hearing peers (Kennedy et al. 2005; Yoshinaga-Itano, 2004). These facts have led to early detection and intervention for infants with hearing loss being the standard of care in developed countries; with countries such as the USA, China and approximately half of all European countries already screening 90-98% of all newborns (Russ et al., 2010; WHO, 2010). No other screening programme has demonstrated the same efficacy as UNIHS programmes in reducing the age of hearing loss identification and producing positive outcomes (Yoshinaga-Itano, 2004; Kennedy et al. 2005). Beyond the benefits to individuals, economic benefits of screening and intervention programmes need to be considered. Long-term economic benefits of universal screening programmes for hearing loss indicate reduced costs for specialised education, social welfare and improved lifetime productivity, quality of life and social integration for individuals with hearing loss (Yoshinaga-Itano & Gravel, 2001; Olusanya, Ruben & Parving, 2006).

EHDI in developing contexts

Unfortunately, the momentum for implementing such widespread EHDI programmes has not carried over to the developing world where two thirds of the world's children with hearing loss reside (Olusanya, Luxon & Wirz, 2004b). Although governmental and non-governmental agencies throughout developing countries have begun to initiate programmes to prevent childhood hearing loss or to offer rehabilitation, little and slow progress toward addressing hearing loss has been reported (Olusanya, 2000, Newton et al. 2001). Poor prevalence and aetiological data for hearing loss in developing countries remains an obstacle to gain support for childhood hearing loss and to plan services (Swanepoel, Hugo & Louw, 2005b; Khoza-Shangase, Kanji; Petrocchi-Bartal, & Farr, 2017). Furthermore, emerging data reporting the mean age of hearing loss detection in South Africa, indicate an average diagnosis of hearing loss between 23 and 44.5 months (Van der Spuy & Pottas, 2008; Butler et. al, 2013; Khoza-Shangase & Michal, 2014; Swanepoel, Johl & Piennar, 2013; Störbeck & Young, 2016), even though hearing loss may have been suspected much earlier (12 to 18 months of age) (Swanepoel, Johl & Piennar, 2013; Störbeck & Young, 2016). UNIHS is virtually non-existent due to the absence of systematic or routine screening programmes in developing countries. The initial detection of hearing loss (in the presence of limited or no newborn hearing screening programmes) is therefore primarily passive, as a result of parental concern about observed speech and language delays, inattention to sound (Olusanya, 2012), unusual behaviour or otitis media complications. The detection period can start from two years old and extend well into the adolescent years (Olusanya, 2001; Russo, 2000). These realities exacerbate the impact of hearing loss on young children in developing countries and consign them to a secluded life with limited access, if any, to education and employment opportunities (Olusanya, 2005). From an ethical and human rights perspective, narrowing avoidable disparities in health care, such as those evident between children with early identified hearing loss and those without, is an important and pressing imperative (Braveman & Gruskin, 2003).

Fortunately, a renewed call from developing countries to advance the plight of children with hearing loss in these regions has been sounded globally (Olusanya et al. 2006). In Africa the only reports, however, have been from Nigeria and South Africa which is an indication of the lack of systematic infant hearing screening programmes on the continent (Olusanya & Okolo, 2006; Swanepoel, Hugo & Louw, 2006). This is certainly true of South Africa where, apart from isolated programmes in private and public health care sectors, early identification of hearing loss is not being attained (Swanepoel, 2006; Swanepoel, Delport & Swart, 2004). A national survey of the public healthcare sector, which caters for about 80% of the population (Dambisya & Modipa, 2009; South African National Treasury, 2010), suggested that no more than 7.5% of public hospitals in South Africa provide some form of newborn hearing screening (NHS) and less than 1% provide UNIHS (Theunissen & Swanepoel, 2008). In addition, a private healthcare sector survey revealed that only 53% of obstetric units offered NHS and, of those, only 14% were universal (Meyer & Swanepoel, 2011). These reviews suggest that more than 90% of infants born in South Africa are left without the prospect of early detection of hearing loss (Theunissen & Swanepoel, 2008; Meyer & Swanepoel, 2011). Challenges in the private sector relate to the service not being systematic or integrated with other birthing packages, accompanied by refusal of services, widespread variation in protocols/practices and a high loss to follow-up (Meyer & Swanepoel, 2012; Meyer & Swanepoel, 2011; Meyer, Swanepoel, Le Roux & Van der Linde, 2012; Khoza-Shangase, Kanji, Petrocchi-Bartal, & Farr, 2017). Similar challenges are evident in the public healthcare sector.

Other challenges in developing countries such as South Africa include the burden of HIV/AIDS on health care. Despite these challenges, it is an important priority to invest in infants and children with hearing loss towards providing more equal opportunities with their hearing peers. Children with hearing loss have been marginalised and benefited less from past public expenditures on essential services and therefore additional costs of including them must be accepted (UNICEF, 2005). The World Health Organisation's definition of health is not just the absence of disease but the complete physical, mental, and social wellbeing of an individual and therefore health beyond survival for those infants with hearing loss can only truly be accessed through early identification and intervention (Olusanya, 2005). Available resources should therefore be distributed equitably in favour of neglected non-life threatening conditions such as infant hearing loss towards

a redress of past funding negligence and a holistic and integrated improvement in population health (UNICEF, 2005; Olusanya, 2006).

These challenges can be significantly reduced through mandating and regulating universal programmes (Swanepoel, Störbeck & Friedland, 2009; Olusanya, Wirz & Luzon, 2008; Swanepoel, Ebrahim, Joseph & Friedland, 2007). Periodic reviews of the state of South African hearing healthcare services to infants with disabling hearing loss and their families should remain a research priority to assist with advocating for further implementation of these services by the South African Government. There is sufficient information that in South Africa the national Department of Health can make a policy decision that it shall be mandatory for all provincial health departments to phase in UNIHS within the next few years.

Legislative support for EHDI in South Africa

Since 1994, the South African Government pledged its commitment to placing priority on children's rights and issues of disability. South Africa has ratified the United Nations Convention on the Rights of the Child in 1995, the African Charter on the Rights and Welfare of the Child in 2000 and the UN Convention on the Rights of Persons with Disabilities in 2008. Section 28 of the Bill of Rights of the South African Constitution of 1996 guarantees that the best interests of the child should be promoted and protected at all times. The Integrated National Disability Strategy (Office of the Deputy President, 1997), The Children's Act 38 (2005), and Education, White Paper 6: Special Needs Education (Department of Education, 2001) further support the rights of children with disability.

The National Health Act., No 61 of 2003. Article 2(c) deals with the promotion of the rights of children, and article 70 deals with research priorities. proposes a preventative approach and highlights the importance of early intervention for children. This preventative approach includes preventing secondary complications, such as developmental delays in language for infants and children with hearing loss. In addition, this paper emphasises the need for Essential National Health Research (ENHR). The *White Papers on an Integrated National Disability Strategy* (1997) and the Whitepaper on the Rights of People with Disabilities (2016) furthermore call for "*early identification of impairments and appropriate interventions*" (including early learning opportunities) within the primary health care system, while they also announce "*free/universal access to assistive devices and rehabilitation services… to all children under the age of six*". The Department of Health (National Health Act 61, 2003) further specifies that free health must be provided for persons with disabilities. In accord with these goals by the Department of Health the Department of Social Development has also produced guidelines for early childhood development services and states that all children with disabilities have the right to inclusion, integration and mainstream facilities and all other benefits enjoyed by non-disabled peers (Department of Social Development, 2006). These rights can only truly be attained and upheld through early identification and intervention for infants with hearing loss. It is clear, therefore, that South African governmental policy guidelines favour the philosophy of screening for hearing loss in infants – it is only the implementation of such policy that is left wanting. Criticism of these policy documents is that they lack specificity in terms of roles and responsibilities, which impacts on implementation of services (Samuels, Slemming & Balton, 2012).

An initial step towards implementation of these policies was taken by the Gauteng Department of Health through issuing Circular 19 in October 2013. The circular supports the implementation of EHDI and recommends that this programme be implemented at all healthcare facilities in the province.

The Board for Speech, Language and Hearing Professions of the Health Professions Council of South Africa issued the year 2007 Position Statement to describe the underlying principles of effective EHDI programmes and provided guidelines and benchmarks for implementing and sustaining accountable EHDI programmes.

This 2015 update provides additional implementation guidelines to facilitate transition from protocol to practice.

V. ROLES & RESPONSIBILITIES

A. Departments and agencies

The Ministries of Health, Social Development and Education are the leading role players charged with the design and implementation of early identification, assessment and education programmes for learners with disabilities in the age group 0-9 years (Department of Education, 2001). Inter-sectoral collaborations between institutions, agencies, departments and units that may be involved in the components of an EHDI programme should be involved in an integrated way assuming responsibility for particular components. A lead agency in conjunction with tertiary training institutions should be appointed to coordinate the implementation, regulation and data management for EHDI programmes in South Africa. The Department of Health's Maternal, Child and Women's Health unit is recommended to steer this initiative alongside other stakeholders such as the unit for Disabilities and Early Childhood Development from the Department of Social Development. Key players in determining provision of services include national, state and district government, multilateral or donor agencies, independent private providers and private-public partnerships (Olusanya, 2007).

Performance of EHDI programmes should be audited through a formally commissioned evaluation of designated pilot programmes. Pilot programmes should include primary as well as secondary and tertiary health care contexts and should be coordinated by the Department of Health in collaboration with tertiary institutions (Petrocchi-Bartal, & Khoza-Shangase, 2016). Academic hospital complexes present ideal contexts for pilot programmes to establish centres of excellence that may serve as a national resource in terms of research data and protocol development for other programmes.

Provincial Departments of Finance, or provincial Treasuries, as well as the provincial Departments of Health are recommended to accept responsibility for ensuring that an adequate dedicated allocation of funds is made to enable screening to take place, using appropriate technology. Provinces must account for the implementation of policies for free health care for persons with disabilities (Office of the Deputy President, 1997). The entire implementation of the EHDI programme should however be attained through an integrated allocation of budgets by the various ministries involved. Initially, funding should be provided for pilot projects and, based on the results, expansion of programmes should be funded. A separate allocation for assistive device technology, specifically for hearing aids must also be ensured. An important aspect noted in Chapter Two of the White Paper on an Integrated National Disability Strategy (1997) under the heading "*Implementation of the RDP to Date*" is that "*Free health care for children under six years old has not always automatically been extended to include rehabilitation and the provision of assistive devices*" (Office of the Deputy President, 1997). Steps must be taken to ensure that this is implemented as an urgent priority. In addition to the funds for assistive devices and appropriate technology, funds must be allocated for the training of personnel in the use of the equipment and the administration of screening programmes at hospitals and in the community.

B. Families and Professionals

The implementation of comprehensive services for effective EHDI programmes must rely on an inter-professional team approach that facilitates collaborations between professionals knowledgeable about childhood hearing impairment (JCIH, 2007). Essential team members are families, audiologists, paediatricians and/ or primary care physicians, otorhinolaryngologists, speech–language therapists, educators, nurses, community workers, other early intervention professionals and interpreters, where needed. The roles of these team members are described further in Table 1.

Table 1: Management of infants and children with hearing loss (summarised from the JCIH Year 2007 Position Statement)

PHYSICIAN	***RESPONSIBILITY***
Paediatrician or primary care physician	• Monitoring general health and well-being of the infant • Assure the audiological assessment is conducted on infants who do not pass their screening in partnership with family and other health care professionals -Initiate referrals for medical speciality evaluations necessary to determine hearing loss aetiology • Monitor middle-ear status because middle-ear effusion can further compromise hearing • Review risk indicators of infant and ensure periodic audiological assessment for infants with risk factors for progressive and/or late onset hearing loss. • Monitor developmental milestones since 30-40% of children with confirmed hearing loss demonstrate developmental delays or other disabilities (Karchmer & Allen, 1999) • Initiate referrals related to suspected disabilities
Otorhinolaryngologist	• Evaluation including clinical history, family history, physical assessment and laboratory tests involving the ears, head, face, neck and such other systems as skin (pigmentation), eye, heart, kidney, and thyroid that could be affected by childhood hearing loss (Tomaski & Grundfast, 1999). • Physical examination of the ear involving identification of external ear malformations (e.g. pre-auricular tags and sinuses, abnormalities or obstruction of ear canals such as the presence of excessive cerumen, and abnormalities of the tympanic membrane and/or middle ear, including otitis media with effusion. • Supplementary evaluations may include imaging studies of temporal bones and electrocardiograms. Laboratory assessments useful in identifying aetiology may include urinalysis, blood tests for congenital or early-onset infection (this includes TORCH infections - toxoplasmosis, syphilis, rubella, cytomegalovirus, herpes simplex virus), and specimen analyses for genetic conditions associated with hearing loss.
Other medical specialists	• A medical geneticist may be required to investigate aetiology in certain cases and to counsel families (More than 300 forms of syndromic hearing loss has been identified and for non-syndromic hearing loss, which comprises the majority of hearing loss cases, 110 chromosomal loci and at least 65 genes have been identified (Morton & Nance, 2006) • Other medical speciality areas may include developmental paediatrics, neonatology, neurology, ophthalmology, cardiology and nephrology to determine the presence of related body-system disorders as part of syndromes associated with hearing loss. • Every child with hearing loss should receive an ophthalmologic evaluation at regular interval to rule out concomitant late-onset vision disorders. • Many infants with hearing loss will have graduated from the NICU and because these infants often demonstrate other developmental disorders the assistance of a developmental paediatrician may be valuable in management of these infants.

Collaborative hearing services that are family-centred are based on the premise that any success a child achieves will be through family intervention, and therefore the ***family*** must be an essential and equal partner in the hearing management team (Mencher et al., 2001; JCIH, 2007). ***Caregivers*** should be involved in the assessment process as this facilitates their understanding of what assessment entails and the next step in the process (Kovacs, 2012). Preliminary results from a South African community indicate that the majority of caregivers evidenced a willingness to participate actively in the screening process which is promising for effective collaborative teamwork in which caregivers are the primary role players (Swanepoel, Hugo & Louw, 2005c). Current caregiver knowledge and awareness of infant hearing loss and the importance of early identification is minimal and services for supportive family education, counselling and guidance should be compiled and made available (Swanepoel, Hugo & Louw, 2005c). Additional barriers in the South African social context such as children without parents and the excessive burden on caregivers will have to be addressed in implementing EHDI programmes for families. Adapting conventional approaches towards these contextual realities is necessary, and adequate support structures must be in place.

As specified by the JCIH Year 2007 position statement ***audiologists*** are central to each component of the EHDI process from identification, audiological evaluation and non-medical management for infants with hearing loss, and coordination of services. As experts in infant hearing loss, audiologists serve in the capacity of programme manager supervising the EHDI programme. In terms of the hearing screening component, the audiologist, in accordance with the HPCSA prescribed minimum EHDI standards, develops the programme according to each context's characteristics and resources. Furthermore, the audiologist manages the programme, assesses quality, trains support personnel, coordinates services and ensures effective transition to evaluation, habilitative and intervention services. For the follow-up component, audiologists diagnostically assess infants to confirm the presence of a hearing loss, evaluate the infant's candidacy for various amplification devices and/or assistive technology, and ensure prompt referral to early intervention services. For the early intervention component, audiologists provide timely fitting and monitoring of amplification (sensory and assistive devices) in addition to education and counselling for families in their ongoing participation in the infants' development. It is vital that information counselling provided by audiologists is tailored to the needs of families (Watermeyer, Kanji & Cohen, 2012). Audiologists and Speech-Language Therapists experienced in the area should additionally provide direct habilitation services to infants (JCIH, 2007) and their families, as well as participate in the assessment of cochlear implant candidacy (JCIH, 2000).

Paediatricians and/or primary care physicians serve as the advocate for the whole child's medical welfare. Paediatricians, especially for screening programmes in NICU's, high care wards, well-baby nurseries, post-natal care and immunisation clinics, are the key professionals overseeing the infant's health and well-being. Newborn hearing screening should therefore be considered as a component of the neonatal examination in order to facilitate prompt referrals by paediatricians to audiologists and/or otorhinolaryngologists (Olusanya, 2012). This will further assist timely referral of high risk infants in contexts where UNIHS services are not yet established (Olusanya, 2012). Screening programmes must therefore be developed and managed in close collaboration and partnership with paediatricians and paediatric nurses as the primary medical practitioners responsible for infants in the NICU, high care wards and well-baby nurseries. Primary care physicians, midwives and nurses at PHC sites perform this advocacy role for infants at this level of care.

Otorhinolaryngologists are essential partners in a comprehensive EHDI programme for the identification, evaluation, and treatment of ear diseases as well as determining aetiologies of hearing loss and related risk factors (JCIH, 2007). Otorhinolaryngologists can assist in the determination of hearing loss aetiology, the presence of related syndromes and risk factors, with support from radiologists and geneticists, as required. Decisions regarding medical and/or surgical treatment in cases of hearing

loss are also made by the otorhinolaryngologist and when such medical intervention occurs, the otorhinolaryngologist also becomes involved in the long-term monitoring and follow-up of the infant. The otorhinolaryngologist is involved in deciding on candidacy for amplification, and surgical intervention, including cochlear implantation and bone-anchored hearing systems if such specialised interventions should be made available (JCIH, 2007).

Screening personnel can include any of the previously mentioned professionals but recommended screening personnel include trained nursing staff, community health care workers, community volunteers, and SLH profession-specific mid-level workers. The human resources in each context must guide the choice of screening personnel. Hospital-based screening in the NICU, high care wards and well-baby nurseries may present an opportunity for community service audiologists or speech-language therapists to conduct the screening, but trained screeners may be more sustainable in the long-run. Screening in primary health care centres where immunisations are given or postnatal follow-ups are offered, present community-based primary health care nurses as the frontline health professionals in the early intervention team. Nursing staff have direct contact with infants and are based at primary health care clinics that are accessible and affordable to the majority of the South African population (Moodley, Louw & Hugo, 2000). Community health workers are also a valuable resource and could be trained to conduct hearing screening in communities. Community health workers who have received focused training have been found to be effective in conducting screening in a community-based infant hearing screening programme in Nigeria (Olusanya, Wirz & Luzon, 2008). A study evaluating the first systematic community-based infant hearing screening programme in South Africa emphasises the need for dedicated screening personnel as opposed to loading already burdened nursing personnel in order to reach sufficient coverage (Friderichs, Swanepoel & Hall, 2012).

Lay volunteers (non-professionals) have also proved to be a valuable human resource in newborn and infant hearing screening programmes. This could be of significant value in South Africa where resources are already limited and there is a lack of health care professionals who are fluent in African languages. A community volunteer can be any person as long as he/she is motivated, has literacy skills and a positive, respectful attitude towards all people (McConkey, 1995); and who has been trained to HPCSA minimum standards for EHDI screening. A South African study showcasing the use of dedicated non-professional screeners highlighted the importance of character, quality of training, experience and regular supervision. Furthermore, the use of dedicated screeners positively influenced programme efficiency and administration (De Kock, Swanepoel & Hall, 2016).

All screening personnel must receive appropriate training in the screening process and technologies and hands-on training in screening infants as well as awareness of referral patterns specific to the context. The training should be provided by audiologists and periodic quality assessments must be included. The training must also empower the screening personnel to provide information counselling by educating mothers and caregivers about the importance of returning for follow-up appointments; providing a description of screening procedures to be conducted,; an explanation of the screening outcome and the implications; reasons for why further testing may be needed; the effect of late-identified hearing loss; and the benefits of early identification and intervention in order to ensure efficient follow-up return rates (ASHA, 2008). It is vital that language and cultural differences be considered within the South African context and that this information conveyed is of the same quality and quantity provided to caregivers who are first language English speakers (JCIH, 2013). The quality of the training will often determine the quality of the programme (McConkey, 1995). For more information on the training of screening personnel refer to section VIII.

The ***family-centred early intervention programme*** for infants with hearing loss is primarily managed by audiologists and/or speech-language therapists or other early interventionists. These professionals must provide appropriate evaluation and treatment for language, speech and cognitive-communication development in close collaboration with caregivers and educators. Education opportunities for the future

must be discussed and pursued with the family towards ensuring optimal opportunities to develop to their maximum potential, allowing them to become participating and contributing members of their communities. Early intervention professionals therefore support the family in stimulation of the infant's communication development, monitor the language, speech, motor, cognitive and social-emotional development of the infant and are knowledgeable and sensitive to the family's needs and are supportive of their priorities (JCIH, 2007). Depending on the needs of the child and family, the early intervention team could also include (but not limited to) individuals with hearing loss, family-to-family support, physiotherapists, occupational therapists, psychologists, and educators with expertise in deaf/blind, developmental delay, and/or emotional/behavioural issues (JCIH, 2013).

VI. PRINCIPLES

In South Africa, a significant number of young children grow up at risk for developmental delay, when compared to children born with an established risk. This may be associated with home environments characterised by poverty, HIV infections, substance abuse, violence and lack of learning opportunities (Samuels, Slemming & Balton, 2012). It is therefore crucial that risks be identified and protective factors be mobilised early. This requires a more cohesive and coordinated early intervention system in South Africa. Such an intervention includes early screening, and referral into family-focused community models of intervention (Samuels, Slemming & Balton, 2012).

The Professional Board for Speech, Language and Hearing Professions of the Health Professions Council of South Africa endorses the development of EHDI systems in South Africa that are family-centred and community-based in agreement with the JCIH Year 2007 position statement. Services must be integrated and coordinated by the relevant stakeholders including the Departments of Health, Social Development and Education with input from private stakeholders and NGO's. These EHDI systems must be available to all infants in a comprehensive, coordinated and timely manner. The following **six principles** are provided as the foundation for effective and accountable EHDI systems in South Africa:

1. All infants are afforded access to **hearing screening using a physiologic measure**. Screening is conducted in four contexts: at discharge from the hospital from (i) the Neonatal Intensive Care Unit (NICU), high care ward or Kangaroo Mother Care (KMC) ward, (ii) well-baby nurseries, (iii) through the immunisation visits at Primary Health Care (PHC) clinics or (iv) through postnatal follow-up visits at Midwife Obstetric Units (MOUs). Apart from those infants in the NICU, the choice of **screening platform is context driven** depending on the amount of home and clinic births in the district health system. These aspects constitute UNIHS in South Africa. Initial hearing screening should be conducted by 1 month of age for infants screened within hospital screening programmes and by six weeks of age for clinic-based programmes.
2. All infants are afforded access to an effective referral system once they do not pass the initial screen and any subsequent rescreen. The referral system is efficient and prompt to appropriate audiologic and medical evaluations to **confirm the presence of hearing loss by 3 months of age for those assessed within hospital-based screening programmes and no later than 4 months of age for those infants enrolled via screening programmes linked to immunisation visits.**
3. All **infants with confirmed permanent hearing loss within hospital-based screening programmes receive intervention services before 6 months of age and before 8 months of age for those infants identified through screening programmes linked to immunisation visits.** Prompt access to assistive devices is ensured and intervention services are provided within inter-professional programmes that are family-centred and asset-based, building on informed choice and recognition of and respect for cultural beliefs and traditions of families.
4. Infants who **pass the initial screen for hearing loss but who demonstrate risk indicators for**

progressive, late-onset bilateral hearing loss or other auditory disorders and/or speech and language delay receive ongoing monitoring by caregivers and/or primary care providers informed of the risks and the communication developmental milestones. **Audiological monitoring** protocols should be aligned with the latest evidence (see VII, section D).

5. **Infant and family rights are guaranteed** through upholding ethical practice in terms of informed choice and consent, and appropriate protection of hearing screening, evaluation and intervention results in agreement with other health care and educational information.
6. Infant and family **information regarding screening and possible follow-up assessments** or services must be **managed by integrated information systems** able to provide data for service development. Such information systems are used to measure and report the effectiveness and efficiency of EHDI services in each District Health System as well as in private hospital complexes. Collective district, provincial and national aggregates are made available to monitor the impact of EHDI programmes on public health and education. Efforts should be made to link or integrate screening, diagnostic and intervention data systems in order to determine long term outcomes of children with hearing loss. The infant and family services received from individual district public and private EHDI programmes should be monitored according to the data they produce to ensure compliant and accountable functioning, to determine cost-effectiveness, to monitor coverage and effectiveness of EHDI implementation, and to ensure continuous quality improvement.

VII. GUIDELINES FOR EARLY HEARING DETECTION AND INTERVENTION PROGRAMMES

The following guidelines have been developed from existing knowledge especially from those included in the JCIH year 2007 position statement and the American Academy of Paediatrics (AAP), and contextual research conducted in South Africa.

Some priorities suggested from established and successful programmes provide guidance on important components that could be considered for successful creation of programmes in South Africa. Some important considerations include:

- Improvement in screening and diagnostic testing protocols of infants to prevent delay in diagnosis and intervention.
- Linking of infants who refer screening with a relevant team member to prevent loss to follow up.
- Increasing timely access to effective early intervention services through centre-, home-based and tele-intervention with provision of unbiased information to families.
- Improving access to loaner hearing aids.
- Improving access to hearing aid batteries, supplies to care for hearing aids, as well as repair budget allocation by public institutions to ensure that assistive devices are functional at all times
- Increasing parent support and public awareness in a manner that is culturally and linguistically appropriate embedded in the system and supported by advocacy groups.
- Ensuring that programme evaluation and continuous quality improvement take place, with improved information systems, allocation of responsibility for monitoring and tracking care and outcome data, agreed-upon programme, process and outcome indicators.
- Moving data from practice to research; and, finally,
- Involvement and empowerment of families and children (Shirley, Dougherty & Jagadish, 2010).

In agreement with the JCIH year 2007 position statement, the South African EHDI position statement of the Professional Board for Speech, Language and Hearing Professions of the HPCSA support the concept of applying a continual process of quality improvement at each of the EHDI components to achieve the desired outcomes. This guideline therefore provides the benchmarks and associated quality indicators for each component of the EHDI system towards monitoring its compliance and outcomes. The benchmarks for EHDI programmes are the quantifiable goals or targets that can be monitored or evaluated. Since very few UNIHS

programmes have been reported in South Africa, the position statement includes benchmarks from the JCIH year 2007 position statement, based on existing international data but also on some reports from South Africa and other developing countries. In instances where published data aren't available, suggested benchmarks are presented. The quality indicators represent a result in terms of the specified benchmark. The quality indicators should therefore be monitored with established measures of statistical practice. Once the quality indicators for a programme are not meeting the stated benchmarks, closer investigation is warranted to identify and correct the process. A discussion of each EHDI principle and the specified benchmarks and quality indicators are presented below.

A. Hearing Screening (Principle 1)

1. Targeted hearing loss and targeted population

The targeted hearing loss is a permanent hearing loss of at least 40 dB averaged over the frequencies 0.5, 1, 2, and 4 kHz. This is in agreement with the European Consensus Development Conference on Neonatal Hearing Screening's position statement (Lutman & Grandori, 1999). This targeted hearing loss is to serve as a minimal criterion for screening programmes in South Africa and as resources become available a more stringent criterion may be instituted, such as that adopted by the JCIH of at least 30 to 40 dB in the frequency region important for speech recognition, unilaterally and bilaterally.

Universal screening is recommended in contrast to previous recommendations of risk-based screening for contexts with limited resources. A number of different studies have reported that the at-risk population only accounts for approximately 50% of infants with congenital hearing loss (Chu et al., 2003; Davis & Wood, 1992; Watkin, Baldwin & McEnery, 1991). Furthermore, the children identified in their first year of life through targeted Newborn Hearing Screening (NHS) have a significantly higher incidence of secondary disabilities (approximately 66%) than the children identified through UNIHS in well-baby nurseries (approximately 30%). This means that the children presenting only with hearing loss, who have the highest potential for success, are most likely to be missed (Yoshinaga-Itano, 2004). In addition to this UNIHS demonstrates better efficacy in terms of accuracy and age of identification than risk-based screening (Grill et al. 2005). Therefore, even though initial savings may be substantial by following a risk-based screening approach, the long-term economic benefits of early identification of hearing loss will be severely compromised if a universal screening model is not applied (Yoshinaga-Itano & Gravel, 2001; Yoshinaga-Itano, 2004). Universal screening programmes have therefore been recommended as the preferred public health care option (Olusanya, Luxon & Wirz, 2005). However, in resource limited settings, the decision of screening strategy may be influenced by the efficiency of the screening programme in terms of the cost per baby screened, cost per infant detected with hearing loss and effectiveness of follow-up (Olusanya, 2012). A study in Nigeria compared targeted and universal, hospital and community-based screening programmes and concluded that the universal community-based programme led to the lowest screening cost per child as well as the lowest cost per child identified with permanent congenital and early-onset hearing loss (PCEHL) (Olusanya, Emokpae, Renner et. al., 2009).

The question of unilateral versus bilateral hearing loss detection becomes a compromise between the effectiveness of the treatment and the costs involved. Research indicates that unilateral hearing loss affects developmental, emotional outcomes (Bess et al, 1998) and academic success in children (Kuppler, Lewis & Evans, 2013) and is a risk factor for a progressive bilateral hearing loss (Murphy & Radford, 2006; Brookhouser, Worthington, & Kelly, 1994). As result, it is recommended that programmes aim for screening protocols that will identify both bilateral and unilateral hearing loss. However, in cases where resource constraints limit the feasibility of this recommendation, programmes may find it more feasible to begin with screening for bilateral hearing loss (unilateral pass criterion), with the goal of moving to screening for unilateral hearing loss (bilateral pass criterion) as screening, diagnostic and intervention resources become available. Limited resources inevitably place a larger emphasis on identifying bilateral hearing loss above the more expensive identification of unilateral hearing loss (Lutman, 2000). It therefore

becomes a matter of selecting a target disorder within the context of available resources, yet ensuring that management of unilateral hearing loss is revisited once resources are made available.

Utilising a unilateral pass criterion targeting bilateral losses will reduce the time of human resources required (especially in terms of follow-ups and follow-up management) compared to a bilateral pass criterion greatly and may prove to be a more feasible intermediate solution to identify children in most need of intervention than risk-based screening (Swanepoel, Hugo & Louw, 2006). This will keep referrals and subsequent costs low compared to a bilateral pass criterion. A unilateral pass criterion ensures that existing resources are implemented to identify bilateral hearing loss, which impacts most significantly on a child's development. By applying a unilateral pass criterion, the monetary and human resource requirements for conducting follow-up evaluations would be reduced significantly (Swanepoel, Hugo & Louw, 2006). A community-based programme that implemented a unilateral pass criterion reported that the initial referral rate would have been three times higher if a bilateral pass criterion was to be implemented. Even with the unilateral pass criterion – the diagnostic follow-up services did not meet the required benchmarks (De Kock et. al., 2016). Once programmes are functioning efficiently (meeting benchmarks) and sufficient capacity has been generated, the protocol can be reconsidered and adapted to include unilateral losses. The review of the protocol should occur within 10 years post-EHDI implementation.

An important recommendation pertaining to a screening protocol targeting bilateral hearing loss, is to monitor all the infants presenting with a unilateral refer result after the initial screen. Although an infant has passed the screen for the targeted hearing loss, a unilateral refer result is a risk indicator for development of a late-onset or progressive bilateral hearing loss (Brookhouser, Worthington, & Kelly, 1994; Murphy & Radford, 2006). This will require that although a unilateral pass meets the screening criteria, the opposite ear must also be screened to establish whether the child may be at risk for a late-onset or progressive bilateral hearing loss. Counselling offered to caregivers should be intensified in these cases and should be accompanied by written information which includes a contact number that can be used when concerns arise.

Where programmes have initiated a screening protocol targeting bilateral hearing loss, this should be revisited on a regular basis to determine readiness for scaling up to a screening protocol targeting unilateral hearing loss in the future.

2. Screening contexts

Western models of newborn hearing screening in NICUs and well-baby nurseries may not be the most appropriate screening contexts across a diverse developing country like South Africa (Swanepoel, Louw & Hugo, 2007). Although Western models of NHS has proven most effective in birthing centres before the neonate is discharged, in developing countries a significant number of births occur outside hospitals (Olusanya, Luxon & Wirz, 2004b). Reports indicate that more than 90% of women deliver at a health care facility (South African Government, 2010). The use of 6-week immunisation visits at PHC clinics as a screening platform provides a way of reaching the entire population with infant hearing screening where hospital-based models will not suffice. The PHC clinics are specifically suited to the delivery of community-based services and therefore provide extensive coverage of infants in South African communities (Swanepoel, Hugo & Louw, 2006; Khoza-Shangase & Harbinson, 2015). In addition to the advantage of improved coverage, repeated immunisation visits scheduled for multi-dose vaccines provide another advantage as a ready avenue to achieve acceptably high follow-up return rates. Initial studies in South Africa and Nigeria reported the feasibility and potential promise of implementing infant hearing screening programmes with existing primary health care structures such as the expanded programme on

immunisation (EPI) (Olusanya, Wirz & Luzon, 2008, Olusanya & Okolo, 2006; Swanepoel, Hugo & Louw, 2006; Swanepoel, Hugo & Louw, 2005c). For a discussion on aspects to consider when implementing screening at PHC immunisation clinics in South Africa, consult reports by Swanepoel, Hugo & Louw (2005c, 2006) and Friderichs, Swanepoel & Hall (2012).

Subsequent research evaluating a systematic IHS programme across eight PHC clinics in the metropolitan area of Cape Town proved to be partly effective with various intrinsic factors resulting in low coverage rates. Postnatal visits at community-based midwife obstetric units (MOUs) are subsequently proposed as an alternative screening platform (Friderichs et. al., 2012). MOUs are birthing units run by midwives in the community for primary healthcare patients. Although discharge at these units usually happens six hours after birth, mothers and infants return to the MOU for postnatal follow-ups focussing on navel care and feeding advice (Western Cape Government, 2011). Research in Gauteng as well as the Western Cape have verified the postnatal visits at MOUs (also called MOU three-day assessment clinics) as a suitable platform for the roll out of NHS rendering high coverage rates, high follow-up rates and one of the most appropriate test times (Khoza-Shangase & Harbinson,2015; De Kock et.al., 2016).

The utilisation of a combination of hospital- and community-based screening may be appropriate. The use of these screening platforms must be determined by each health district and must aim to optimise the district screening coverage in the most cost-effective manner (Khoza-Shangase et al., 2017).

3. Programme protocol development

The team of professionals responsible for screening in the selected contexts must conduct a comprehensive review of the prevailing infrastructure of the hospital or clinic before implementation of the screening programme. Developing hospital-based screening in the NICU, high care wards, KMC wards and well-baby nurseries should consider technology, timing of the screening relative to discharge, availability of possible screening personnel and acoustically appropriate environments, follow-up referral criteria, information management, and quality control. Community-based screening programme development (within a PHC framework) must consider similar aspects including technology, timing of screen (postnatal visit at MOU or first immunisation visit at 6 weeks), coordination of follow-up screens in a way that will maximise follow-up return rates, acoustically appropriate environments, availability of screening personnel, follow-up criteria, access to diagnostic evaluations, information management and quality control (Swanepoel, Hugo & Louw, 2006, Friderichs et. al., 2012, De Kock et. al., 2016). Studies have indicated that hearing screening results are more often recorded on clinic records rather than on Road to Health Cards and that there is a lack of consistency between clinics (Petrocchi-Bartal, 2011; Joubert & Casoojee, 2013). Hence, reporting and management of communication must be clearly defined including documentation of screen outcomes on medical records (Road-to-Health card), the contents of reports to families and physicians, and methods for reporting to district health and national data sets. Methods for ensuring that communications with families are confidential, culturally sensitive and an understandable format and language must also be clearly defined (JCIH, 2007).

4. Screening technologies

Physiologic measures are preferred and must be employed to identify newborns and infants with the targeted hearing loss (WHO, 2010; Olusanya, 2011). The use of a noise-emitting device such as a rattle, a whistle or any other instrument or the whisper test which are not objective means of testing hearing therefore not endorsed for hearing screening. Such subjective screening techniques have demonstrated poor sensitivity for hearing losses other than those of a profound degree and low specificity rates, making them unreliable and inappropriate (Downs & Sterrit, 1967; Northern & Downs, 2002).

Two physiological screening technologies are endorsed including Oto-Acoustic Emissions (OAEs), both

distortion product (DPOAE) and transient evoked (TEOAE), and the Automated Auditory Brainstem Response (AABR). OAEs are a measure of outer hair cell functioning in the cochlea and the Auditory Brainstem Response (ABR) a measure of neural synchrony in the VIIIth nerve and lower brainstem. The sensitivity and specificity of current OAE and AABR screening methods have proved to produce low false-positive rates of 2-3%, with some reports of less than 1% (Iwasaki et al., 2004; Lutman & Grandori, 1999; Lutman, 2000; Prieve & Stevens, 2000; Spivak et al., 2000), and false-negative rates of between 6-15% as determined by studies with follow-up procedures for the entire cohort (Kennedy et al., 1998; Vohr et al., 1998; Watkin, 1996). According to Lutman (2000), both OAE and AABR techniques can achieve specificity in excess of 95%. UNIHS Cebulla, Hofmann & Shehata-Dieler (2014) reported on five AABR-based screening studies that achieved specificity rates between 96.8% and 99.4% and sensitivity rates between 82% and 100% (four out of five of these studies that reported a sensitivity rate of100%).

Utilising AABR and OAE technologies to screen for the targeted hearing loss requires that interpretive criteria, based on a clear scientific rationale for pass and refer be established for each test procedure. Automated response detection criteria are included in almost all OAE and ABR screening equipment and preferred above decision-making based on subjective interpretation. This reduces the effects of screener bias, errors on test outcome, and ensures consistency across all infants, test conditions, and screening personnel (JCIH, 2007). Whilst it is acknowledged that the detection criterion may differ between equipment, an overall pass result should comprise of a pass at 50% or more of the frequencies on the equipment being used. Furthermore, the pass criterion for AABR should consist of a pass at 35dBnHL.

Recommendations regarding screening technologies for different screening contexts are made as follows: AABR screening, although it may be more expensive than OAE based on initial capital expenditure and/or due to increased disposable costs, is recommended as the technology of choice for screening infants with risk factors for auditory neuropathy spectrum disorder before discharge (Kezirian et al. 2001; Vohr et al. 2001). The NICU population has an increased prevalence of auditory neuropathy spectrum disorder associated with the presence of multiple risk indicators for hearing loss and since it is a neural condition it can only be identified with a neural-based test such as the ABR (Berlin, 1999; Sinninger, 2002). AABR may be a more suitable test for infants who are small for gestational age and/or have low birth weight (Hall, Smith & Popelka, 2004).

Traditionally, OAE screening has conventionally been recommended instead of AABR screening at immunisation visits for infants without risk factors for auditory neuropathy spectrum disorder. (Swanepoel, Hugo & Louw, 2006). Conducting an AABR screening on infants past neonatal age becomes increasingly difficult since the babies are more restless and irritable and they become less trusting of unfamiliar personnel as they grow older (Palmu et al. 1999; Swanepoel, Hugo & Louw, 2005c). Since the AABR requires more preparation in the form of placing the electrodes and ensuring sufficient impedance, it becomes more difficult to test the infants attending the immunisation visits, whereas a simple OAE procedure requires only a probe placement, which results in a shorter average test time (Swanepoel, Hugo & Louw, 2006). However, new developments in AABR technology addressing the issues of preparation- and test time as well disposable costs (Cebulla & Shehata-Dieler, 2012; Cebulla et al., 2014) are broadening the application possibilities of AABR screening even in community-based settings (De Kock et al., 2016). Ambient noise levels will have to be considered within contexts where OAE screening is conducted in order to minimise false positive results. In addition, noise reduction capabilities and signal processing techniques of the OAE equipment in different settings would need to be explored as not all OAE instruments may be suitable for UNIHS (Olusanya, 2010).

While immittance testing is not recommended as a part of an infant hearing screening protocol, it should be noted that high frequency tympanometry using a 1000Hz probe tone may be used in follow up testing to differentiate the reason for OAE refer results (Swanepoel, Louw & Hugo, 2007).

5. Screening protocols

Various international screening protocols for hospital-based UNIHS have been implemented successfully to provide access to hearing screening for all newborns before they are discharged. Protocols vary from inpatient screening providing one or more repeat screens using the same or different technologies or outpatient rescreening within one month after discharge (JCIH, 2000).

South African protocols must be developed within each context to maximise the follow-up return rate and minimise the number of false-positive referrals for audiological diagnosis. These contextually relevant protocols must be guided by the recommendations emerging from the current body of knowledge regarding protocols for the NICU and PHC clinic based screening contexts. Infants admitted to NICU or high care wards are an established at-risk population with up to 10 times higher prevalence of sensory and neural hearing losses for which the ABR is sensitive (Polinski, 2003; Suzuki & Suzumura, 2004; Yoon et al., 2003:354). For this population, first and second stage AABR screening prior to discharge is recommended. The AABR is less affected by middle-ear effusion, which NICU infants are prone to, and yields slightly better sensitivity and specificity rates for initial screens (Engel et al., 2001; Hall, Smith & Popelka, 2004).

Screening protocols using immunisation visits at PHC clinics are recommended to employ OAE technology and must be carefully planned to coincide with subsequent visits towards ensuring efficient follow-up return rates which is a significant challenge, even in developed countries (JCIH, 2007). The first immunisation visit is scheduled for 6 weeks followed by visits at 10 and 14 weeks and then 9 months. This implies that follow-up rescreens coinciding with the second immunisation visit will be within one month from the initial screen when infants discharged from well-baby nurseries are approximately 2.5 months of age. The JCIH recommends identification of hearing loss before three months of age which allows the screening schedule at 6-week visits with limited time for follow-up and confirmation of hearing loss before 3 months of age. In addition to this challenge, an infant's first immunisation may well occur any time during the first year of life even though it is scheduled for six weeks after birth and the older infants are often more difficult to test than newborns which may result in less successful infant screens (Children in 2001, 2001; Palmu et al., 1999). It remains clear, however, that a 3-month benchmark for confirmation of hearing loss in infant hearing screening programmes at these PHC clinics is not attainable at present. This benchmark must therefore be extended to up to 4 months for screening programmes linked to immunisation visits to allow enough time across three immunisation visits (6, 10 & 14 weeks) for rescreens and diagnostic assessments. A fourth immunisation visit scheduled for 9 months may be used for monitoring infants at risk for late-onset or progressive hearing loss. Refer findings from repeat screenings conducted at PHC clinics warrant the need for referral for diagnostic assessment at secondary or tertiary level hospitals depending on the referral system within each district

Recommendations emerging from recent research suggest that screening linked to postnatal follow-up visits (also called three-day assessment visits) at MOUs has the potential to become the most effective community-based platform for screening (Khoza-Shangase & Harbinson, 2015; De Kock et al., 2016). The protocol entails integrating or aligning hearing screening with postnatal follow-up visits, which according to the Road-to-Health booklet, is scheduled for day three and seven after birth. However, in practice some variance occurs, with MOUs often recommending that mothers and babies return every second day until the umbilical cord falls off. The protocol for initial and follow-up screening should be set up to coincide with the follow-up protocol of the MOU. This community-based platform poses the advantage that screening and rescreening can take place within the first two weeks of life, allowing compliance with the relevant benchmarks. OAE has been the technology of choice for community-based screening but research indicates that advances in technology (addressing disposable cost and test time) now make AABR a viable option for the MOU context. AABR screening would add the advantage of lower referral rates, higher true positive rates, more effective screening at an earlier age as well as the capability

to identify neural losses (De Kock et al., 2016).

Timely and efficient confirmation of hearing loss for infants screened through community-based programmes will require an integrated multi-disciplinary follow-up system. An essential component will be the education of mothers/caregivers regarding the importance of returning for follow-up appointments, the effect of late-identified hearing loss, and the benefits of early identification and intervention. Mothers who are better educated are more likely to return for the full set of vaccinations and probably also for the follow-up hearing screenings and evaluations (Children in 2001, 2001). Ideally, education should start antenatally and opportunities to include information regarding infant hearing and hearing screening in antenatal care, should be explored.

6. Caregiver concern regarding hearing screening

The reports from developed countries are uniform in their conclusions that parental anxiety due to screening programmes is negligible and does not differ significantly from that of parents whose infant did not receive screening. In addition to this, parents of children with hearing loss demonstrate emotional availability similar to parents of children with normal hearing (Yoshinaga-Itano, 2003). In a study of parents of severely deaf children, 96% indicated that they would have wanted neonatal identification. Only a small portion indicated that they would have preferred to have waited because of the anxieties caused (Watkin et al., 1995). Clemens, Davis & Bailey (2000) in a study of 5 010 infants report that 90% of the mothers indicated UNIHS to be a “good” idea, while Hergils and Hergils (2000) indicate that 95% of the parents in a study in Sweden had a positive attitude towards NHS.

According to a report by Yoshinaga-Itano (2003) neonatal identification of hearing loss through UNIHS programmes does not result in greater parental stress than later-identification of hearing loss when the intervention programme contains a comprehensive counselling content. In a study of 184 parents of children with hearing loss, the parents of early-identified children were not more likely to present with stress than parents of late-identified children (Yoshinaga-Itano, 2003). Colorado data indicates that 10% of parents of infants referred for follow-up after NHS report negative emotions (Yoshinaga-Itano & Gravel, 2001). The reported stress of parents who pass the hearing screening does not prove to be significantly different from the stress reported by parents of children who have been referred for diagnostic testing (Yoshinaga-Itano & Gravel, 2001). Preliminary data also indicates that resolution of grief by families with early-identified children occurs faster than for families with later-identified children, as long as their children develop strong language and communication skills (Yoshinaga-Itano, 2003). In general, parents report that UNIHS programmes have improved their awareness of the importance of hearing, language and speech development and as a result of this exposure they can pay more attention to their child’s communication skills (Yoshinaga-Itano & Gravel, 2001).

Unfortunately, little data is available for caregiver perceptions of early identification of hearing loss in developing countries like South Africa. Only a few published reports from Africa have provided information on maternal views on hearing loss in the region (Olusanya, Luxon & Wirz, 2006; Swanepoel, Hugo & Louw, 2005c; Swanepoel & Almec, 2008) Results from surveys in developing contexts such as Nigeria and South Africa have indicated a favourable attitude towards early detection and intervention of childhood hearing loss from mothers. Mothers were willing to have their baby’s hearing screened, but some concern regarding the level of awareness and knowledge of childhood hearing loss and the benefits of early detection was noted (Olusanya, Luxon & Wirz, 2006; Swanepoel, Hugo & Louw, 2005c; Swanepoel & Almec, 2008). Screening programmes in South Africa should be sensitive to cultural tradition and religious beliefs influencing perceptions of childhood hearing loss (Olusanya & Okolo, 2006; Swanepoel, Hugo & Louw, 2006; Khoza-Shangase, Barratt, & Jonosky, 2010). Research surveys must be conducted alongside the implementation of EHDI programmes in South Africa to ascertain caregiver perceptions on hearing loss and newborn and infant hearing screening towards culturally congruent

screening programmes.

Aligned with the JCIH recommendation, EHDI programmes should be monitored monthly according to the key quality indicators to ascertain whether a programme is meeting the expected outcomes. This allows prompt recognition and correction of any unstable component of the screening, diagnostic and intervention process (JCIH, 2007). Additional key indicators may be monitored less frequently.

7. Benchmarks and quality indicators for newborn and infant hearing screening

a) Recommended universal newborn and infant hearing screening benchmarks

Hospital-based screening:

- Within 6 months of programme initiation, hospital-based screening programmes should screen 95% of infants before discharge or before 1 month of age.
- The referral rate of the screening process for audiological and medical evaluation should be less than 5% within one year of programme initiation
- The audiologist managing the programme must document efforts to follow-up on a minimum of 95% of infants referring the initial screen. A 70% and higher follow-up return rate is considered ideal. Successful follow-up is influenced by various factors such as lack of adequate demographic information, changes in addresses or contact details, access to facilities and personal constraints such as poverty, which may impact the feasibility of attaining a 70% follow-up return rate.

Community-based screening:

- Within 6 months of programme initiation, community-based screening programmes should screen 95% of infants attending their 6-week immunisation or postnatal follow-up visit
- The referral rate of the screening process for audiological and medical evaluation should be less than 5% within one year of programme initiation
- The audiologist managing the programme must document efforts to follow-up on a minimum of 95% of infants referring the initial screen. A 70% and higher follow-up return rate is considered ideal. Successful follow-up is influenced by various factors such as lack of adequate demographic information, changes in addresses or contact details, access to facilities and personal constraints such as poverty, which may impact the feasibility of attaining a 70% follow-up return rate.

b) Associated quality indicators of the EHDI programme screening component (Table 2 & Table 3 below)

Table 2: Quality indicators for hospital-based screening

Key quality indicators	Additional quality indicators
Percentage of newborns screened before discharge and/or before one month of age	Percentage of infants whose screening was not done and where possible, documented reasons for this
Percentage of infants who do not pass the hospital-based screen	Percentage of infants with a unilateral refer result (for programmes utilising a unilateral pass criterion)
Percentage of infants who do not pass the hospital-based screen who return for follow-up services	Percentage of families who refuse hospital-based hearing screening
Percentage of infants who do not pass the hospital-based rescreen who are referred for audiologic	Percentage of caregivers reporting a positive attitude toward the screening programme after the

and/or medical evaluation	first screen

Table 3: Quality indicators for community-based screening

Key quality indicators	Additional quality indicators
Mean age at initial screening	Percentage of infants with a unilateral refer result (for programmes utilising a unilateral pass criterion)
Percentage of infants who do not pass the community-based screen	Percentage of families who refuse community-based hearing screening
Percentage of infants who do not pass the clinic-based screen who return for follow-up services	Percentage of caregivers reporting a positive attitude toward the screening programme after the first screen
Percentage of infants who do not pass the community-based rescreen who are referred for audiologic and/or medical evaluation	

B. Confirmation of Hearing Loss in Infants Referred from NHS (Principle 2)

Infants in hospital-based screening programmes as well as those in screening programmes linked to community-based postnatal follow-up visits who meet the referral criteria for diagnostic audiologic and medical evaluations should be evaluated before 3 months of age. Infants in clinic-based screening programmes where the earliest initial screen takes place at 6-weeks of age should receive diagnostic evaluations before 4 months of age. Referrals should be for comprehensive audiologic assessment and speciality medical evaluations to confirm the existence of a hearing loss and to determine the type, degree, and if possible the aetiology of the hearing loss. Diagnostic audiologic assessments must be scheduled at the nearest facility (secondary or tertiary) with the necessary equipment to conduct appropriate assessments including diagnostic OAE and Auditory Evoked Potential equipment. Medical assessments must be referred to the nearest referring secondary health care facility. The programme manager in each district must coordinate services and address family concerns. Evaluations are described in the following sections.

1. Audiologic evaluation

Diagnosing the presence of a hearing loss and ascertaining the type and degree of the loss must be performed by a registered audiologist with experience in diagnosing infant hearing loss. An audiologic test battery including physiologic measures and developmentally appropriate behavioural techniques must be employed towards an accountable diagnosis of a hearing loss. No single test procedure may be used but a battery of tests to cross-check the results is necessary (Bachman & Hall, 1998; Jerger & Hayes, 1976). According to the JCIH (2007) audiological measures within the test battery should be used to assess the integrity of the auditory system, determine the type and estimated degree of hearing sensitivity, establish a baseline for monitoring and provide information for fitting of an amplification device. All audiologic assessments of young infants should provide ear-specific estimates of the type, degree, and configuration of the hearing loss.

Test-batteries for infants younger than 6 months of age should include a child and family history, an electrophysiologic measure of threshold such as ABR (neurodiagnostic and threshold estimation using frequency specific stimuli i.e. tone burst/tone pip or CE Chirps) and ASSR, diagnostic distortion product or transient evoked OAEs, assessment of middle-ear functioning, acoustic reflex thresholds, observation

of the infant's behavioural response to sound, and parental report of emerging communication and auditory behaviours (JCIH, 2007). Children suspected of having auditory neuropathy spectrum disorder require a diagnostic ABR, including testing of cochlear microphonic, in order to confirm or exclude this diagnosis. Where auditory neuropathy spectrum disorder is confirmed, ASSR should not be conducted, as ASSR results cannot be used for threshold estimation in these cases. Detailed guidelines for electrophysiologial assessment are provided by the NHSP Clinical Group (2013); the Australian Healthy Hearing Program (2009) as well as by Hall and Swanepoel (2010). Sedation practices should be carefully considered for electrophysiological testing, with testing under natural sleep being the recommended method in infants below 6 months of age.

Appropriate measures of middle-ear functioning include tympanometry with high frequency probe tones of 1000 Hz (Baldwin, 2006; Margolis et al. 2003; Kei et al. 2003; Swanepoel et al. 2006), bone conduction ABR or ASSR (Cone-Wesson & Ramirez, 1997; Small & Stapells, 2006) and pneumatic otoscopy. The use of high frequency tympanometry has proven useful in classifying ears into different risk categories for sensorineural hearing loss and middle-ear effusion (Baldwin, 2006; Margolis et al. 2003; Swanepoel, Hugo & Louw, 2006; Swanepoel et al. 2007). Based upon these results, appropriate referrals can be made to medical personnel immediately for treating a possible middle-ear effusion (Yoshinaga-Itano, 2004). Otitis media with effusion is an important cause of transient, moderately severe hearing impairment in the first months after birth.

Once a child is able to sit unaided, which is usually around 6 months of age, the test battery can be amended. The **test-battery for infants and toddlers between 6 through 36 months of age** should include a child and family history, ear-specific behavioural response audiometry according to the child's developmental age (visual reinforcement or conditioned play audiometry), speech detection and recognition measures, parental report of auditory and visual behaviours, and a screening of communication and language milestones (JCIH, 2007). Acoustic immittance measures and physiologic measures such as OAE, ABR and ASSR may also be conducted, as necessary (Hall & Swanepoel, 2010).

The diagnosing audiologists must make a decision in consultation with the family regarding appropriate intervention options and necessary referrals based on the evaluation outcome. The audiologist must provide intervention alternatives to the caregivers. Subject to the choices made by caregivers regarding amplification and communication mode, the audiologist will schedule follow-up appointments to provide personal amplification systems and identify appropriate professionals to assess the child's level of functioning and provide comprehensive unbiased family-centred intervention services. It is also the responsibility of the diagnosing audiologist to keep record of the dates of diagnosis, fitting of amplification and referral to intervention services. The audiologist should follow up children who missed appointments and document such efforts.

2. Medical evaluation

Infants with confirmed hearing loss and/or middle ear dysfunction should be referred for otologic and other medical evaluations as needed. The purpose of these evaluations include determining the aetiology of hearing loss, identifying related physical conditions, recommending medical treatment and referral for other services as necessary. Necessary components of the medical evaluation include clinical history, family history, physical examination as well as indicated laboratory and radiologic studies. An otorhinolaryngologist may also consult with a geneticist for chromosome analysis and evaluation of specific syndromes associated with hearing loss (JCIH, 2007).

A summary of medical professionals involved in managing the infant with a hearing loss and their responsibilities in the team is listed in Table 3.

3. Benchmarks and quality indicators for confirmation of hearing loss

a) Recommended benchmarks for confirmation of hearing loss

Hospital-based screening:

- Infants referred in the hospital-based screening programme complete audiologic and medical evaluations by 3 months of age or 3 months after discharge for NICU infants
- Infants with evidence of a hearing loss receive an otologic evaluation
- Families and professionals perceive the audiologic and medical evaluation process as positive and supportive
- Families receive support in terms of referral to appropriate intervention programmes, and provision of information to families regarding hearing loss and intervention options.

Community-based screening:

- Infants referred in the community-based screening programme complete audiologic and medical evaluations before 4 months of age if referred via immunisation visits or before 3 months if referred via postnatal follow-up visits
- Infants with evidence of a hearing loss receive an otologic evaluation
- Families and professionals perceive the audiologic and medical evaluation process as positive and supportive
- Families receive support in terms of referral to appropriate intervention programmes, and provision of information to families regarding hearing loss and intervention options.

b) Associated quality indicators of the confirmation of hearing loss (Table 4 and Table 5 below)

Table 1: Quality indicators of the confirmation of hearing loss for hospital-based screening

Key quality indicators	**Additional quality indicators**
Percentage of infants whose audiologic and medical evaluations are obtained before an infant is 3 months of age	Percentage of infants with confirmed hearing loss referred for otologic evaluation
Percentage of infants with confirmed hearing loss	Percentage of families who accept audiologic and medical services

Table 2: Quality indicators of the confirmation of hearing loss for community-based screening

Key quality indicators	**Additional quality indicators**
Percentage of infants whose audiologic and medical evaluations are obtained before an infant is 4 months of age if referred via immunisation visits or before 3 months of age if referred via postnatal follow-up visits	Percentage of infants with confirmed hearing loss referred for otologic evaluation
Percentage of infants with confirmed hearing loss	Percentage of families who accept audiologic and medical services

C. Early Intervention (Principle 3)

Early intervention for infants and young children with hearing loss has demonstrated the potential to positively influence and change cognitive and developmental outcomes in a very significant manner (Kennedy et al. 2005; Moeller 2000; Yoshinaga-Itano, 2004; Yoshinaga-Itano et al. 1998). These benefits are attributed to the principle of critical developmental periods allowing for optimal cognitive, language and speech development that are accessed most effectively early in life. The components of the early intervention system are therefore designed to capitalise on this principle towards the development of each child's full potential.

1. Early intervention programme development

The primary member in an early intervention team is the family and therefore the programme must be designed to be responsive to the needs of each infant and his/her family. This includes addressing aspects such as the acquisition of communicative competence, social skills, emotional well-being, and positive self-esteem within a culturally congruent programme (JCIH, 2007; Louw & Avenant, 2002). Essential principles of effective early intervention are described by the JCIH year 2007 position statement. In a country like South Africa, however, the characteristic linguistic, racial and cultural diversity requires the development of culturally appropriate early intervention programmes (Louw & Avenant, 2002). Children acquire language within the family context where there is a dynamic interaction between language, culture, values and child rearing practices. It is therefore imperative that models of early intervention be sensitive and incorporative of the cultural-linguistic context for intervention since acquiring language and becoming a cultural member are deeply embedded processes (Louw & Avenant, 2002). A detailed consideration of using culture as the context for intervention for children with hearing loss is provided by Louw and Avenant (2002).

The primary health care approach adopted by the South African government requires that first world models of early intervention service delivery be adapted to adhere to the public health care philosophy of community-based primary health care (Fair & Louw, 1999). As a result, the integration of conventional early intervention models and a community-based model of service delivery as proposed by Fair and Louw (1999) should guide EHDI service delivery. The individual strengths of the two models are anticipated to be a powerful means of preventing primary, secondary and tertiary communication disorders through community participation (Fair & Louw, 1999).

In a developing country like South Africa, with limited early intervention support services, a 'scaling up' approach to service delivery is recommended (Olusanya et al. 2007). Successful public health programmes often start small followed by a systematic scaling up of services. Despite the fact that adequate support services in all communities are not yet available the early detection of hearing loss will provide the incentives for the systematic scaling up of services to meet the emerging and growing needs (Olusanya et al. 2007). Existing centres of excellence and professional expertise should be accessed to guide the development of intervention services for infants and young children from the age of diagnosis. Legislative support for early intervention services by the managerial and consultative participants in the community-based intervention process is necessary even if pilot projects are identified as an intermediate step (Fair & Louw, 1999). The responsibility for ensuring adequate allocation of funds for such projects must be negotiated between Provincial Directorates of Finance and research councils such as the Medical Research Council (MRC) and National Research Foundation (NRF) and even international organisations such as the World Bank, UNICEF and WHO. Intervention services may require setting up public-private partnerships in the initial stages towards developing more comprehensive intervention programmes for infants and children with hearing loss relying on the private and public health care systems. Ultimately however the services should be integrated within government programmes and priorities in order to be sustainable.

Most intervention services are delivered at a health facility level. This means that access to assessment, support and intervention services is often challenging for vulnerable families (Samuels, Slemming & Balton, 2012). Whilst hearing assessment and audiological intervention require management at a health care facility, communication intervention for these children may follow a different model. Two possible methods for this are community-based rehabilitation and increased outreach activities to home and communities.

Healthcare facility-based services should focus on caregiver education and training in promoting communication and overall child development. Additional resources that address the early intervention needs of families of infants with hearing impairment should be offered (Störbeck & Moodley, 2011).

In 2013, the JCIH issued a supplement to their 2007 position statement, specifically focussing on principles and best practice guidelines for the implementation of early intervention after confirmation of hearing loss. It provides 12 goals with specific recommendations and promotes continuous evaluation in order to keep improving the quality of care for children with hearing loss and their families.

2. Audiologic habilitation

The Board's position is aligned to the rights of Persons with Disabilities (in particular, children) as set out in the Constitution, and the Children's Act of 2005, as well as the UN Convention on the Rights of Persons with Disabilities (2008) and the Whitepaper on the Rights of People with Disabilities that parents/guardians are the decision makers regarding their child's habilitation. It is also guided by new initiatives on Early Childhood Development by national government through the national Department of Social Development

Personal amplification or sensory device of some form is recommended for all infants and children identified with the targeted hearing loss. Families are responsible for choosing personal amplification for their infant after they have been informed regarding the various options. Audiologists are responsible to conduct hearing aid selection and fitting in a timely fashion to minimise the amount of time between diagnosis and amplification (JCIH, 2007).

The provision of the personal amplification device should be based on physiologic threshold information if behavioural estimations are unreliable or unobtainable. Corroborating physiologic thresholds with behavioural thresholds as soon as an infant is able to provide reliable responses should be included in the follow-up schedule. The goal of amplification fitting is to provide an infant with maximum access to the acoustic spectrum of speech within a range that is safe and comfortable (JCIH, 2007). The amplification fitting protocol should include the following:

- Prescriptive procedures that incorporate individual real-ear measurements
- Validation of the benefits, particularly for speech perception, in typical listening environments
- Complementary or alternative sensory technology (FM systems, vibrotactile aids and cochlear implants) may be considered according to degree of hearing loss, goals of auditory habilitation, acoustic environments, and family's informed consent
- Long-term monitoring of personal amplification by audiologic assessment; electroacoustic. real-ear, and functional checks as well as refining prescriptive targets
- Long-term monitoring of communication, language, social emotional, cognitive and later academic development to assure that progress is commensurate with the infant's abilities.

(JCIH, 2007; Pediatric Working Group of the Conference on Amplification for Children with Auditory Deficits, 1996)

Otitis media with effusion (OME) should be promptly identified and monitored since it can further compound the sensory or permanent conductive hearing loss which reduces access to auditory/oral language stimulation and spoken language development. Referral to otorhinolaryngologists for treatment of persistent OME is therefore indicated to ensure that amplification fitting is not delayed. In the event of an underlying sensori-neural hearing loss or a chronic conductive hearing loss, fitting of amplification should not be delayed while management of OME takes place.

3. Medical and surgical intervention

Medical and surgical intervention required for infants with hearing loss may vary from the removal of cerumen and the treatment of OME to long-term plans for reconstructive surgery and assessment of candidacy for cochlear implants. Surgical intervention for the malformation of the outer and middle ears should be investigated in cases of permanent conductive or cases of sensory and permanent conductive losses. In the event of middle ear effusion in the presence of normal hearing levels and no additional risk factors, watchful waiting is recommended for a period of three months at a time, as opposed to medical or surgical intervention (Bull et al, 2008). Surgical intervention may be considered for infants with sensori-neural hearing loss, who comply with the cochlear implantation criteria and demonstrate poor benefit from conventional amplification. The field of cochlear implants is rapidly expanding in South Africa with several implant teams around the country (Swanepoel, 2006). Many medical aids contribute to the costs of the implants and several public health care facilities implant a limited number of candidates who are unable to afford the device. Public-private partnerships may lead to increasing numbers of infants with hearing loss in the public health care sector receiving cochlear implants.

4. Communication assessment and intervention

Language acquisition underlies cognitive, social and emotional development in a synergistic manner (JCIH, 2007). A complete language evaluation, including oral, manual, and/or visual mechanisms and cognitive abilities should be performed for infants and young children with hearing loss. This information provides a baseline from which to support families in developing the communication abilities of their infants. Families should be provided with unbiased information specific to language development and with family-involved activities that facilitate language development in a culturally relevant manner. According to the JCIH (2000) "*the specific goals of early intervention are to facilitate developmentally appropriate language skills, enhance the family's understanding of its infant's strengths and needs, and promote the family's ability to advocate for its infant.*" Families must therefore be allowed to make an informed decision regarding the communication methods including oral and visual language systems. Providing the services includes monitoring participation and progress to adapt and modify the intervention as needed. Documenting the intervention approach systematically will allow such decision making.

5. Benchmarks and quality indicators for early intervention

a) Recommended benchmarks for early intervention

- Infants with hearing loss are enrolled in a family-centred early intervention programme before 6 months of age and no later than 8 months for those identified through screening programmes linked to immunisation visits
- Infants with hearing loss are enrolled in a family-centred early intervention programme with professional personnel who are knowledgeable about general child development and the communication needs of infants with hearing loss
- Infants with hearing loss and no medical contraindication begin using amplification (when appropriate and agreed upon by the family) within one month of confirmation of the hearing loss
- Infants with amplification receive ongoing audiologic monitoring at intervals not exceeding 3 months

in the first 1 to 2 years of life and not exceeding 6 months until 5 years of age (Feirn et al., 2014) **The guidelines for fitting hearing aids to young infants by the Newborn Hearing Screening Programme Clinical Advisory Group (Feirn et al., 2014) serve as a useful resource*.

- Infants at risk for a progressive hearing loss receive hearing surveillance, guided by the condition's likely progression, as per guidelines in section D below.
- Infants enrolled in early intervention achieve language development in the family's chosen communication mode that is commensurate with the infant's developmental level
- Families participate in and express satisfaction with self-advocacy
- Interaction between the multidisciplinary team serving the family (including but not limited to the audiologist, early interventionist, occupational therapist, otorhinolaryngologist, paediatrician and physiotherapist)

b) Associated quality indicators for early intervention may include (Table 6):

Table 3: Quality indicators for early intervention

Key quality indicators	Additional quality indicators
Percentage of infants who have been fitted with amplification by the age of 6 months (if applicable, and if selected by the families)	Percentage of infants in early intervention who receive language evaluations at 6-month intervals
Percentage of infants with hearing loss who are enrolled in a family-centred early intervention programme before 6 months of age, and before 8-months of age for those identified through screening programmes linked to immunisation visits	Percentage of infants with amplification who receive ongoing audiologic monitoring as per the above benchmark
Percentage of infants and toddlers whose language levels, whether spoken or signed, are commensurate with those of their developmental level upon entry into school	Percentage of families who refuse early intervention services
Percentage of infants receiving follow-up visits for amplification monitoring and adjustment, at intervals not exceeding 3 months within the first year following amplification fitting	Percentage of families who participate in and express satisfaction with self-advocacy

D. Continued Surveillance of Infants and Toddlers (Principle 4)

Risk-based screening involves screening all newborn and infants presenting with one or more risk factors for hearing loss. During the 1950s and 1960s the Hardy Group in the USA focused on the development of a list of etiological factors for sensorineural hearing loss that eventually became known as the High-Risk Register (HRR) for Hearing Loss (Mencher et al., 2000). In 1973 the JCIH recommended that mass newborn behavioural screening be discontinued in favour of testing only those infants determined to be at-risk according to five identified risk criteria on the HRR (Mahoney & Eichwald, 1987). The JCIH revised this statement in a 1982 statement when it updated the recommendations and added two more criteria to the original five high-risk indicators (JCIH, 1982). This recommended screening practice subsequently evolved to universal screening due to advances in technology and the poor yield of infants with hearing loss by high-risk screening. Pilot projects and continued improvements in technology demonstrated these techniques to

be a fast, accurate and cost-effective means of screening newborns making UNIHS a feasible possibility (Hall, 2000; Northern & Downs 2002; Roizen, 1998; Vohr et al., 1998). Furthermore, risk-based screening, despite existing for decades in the USA, failed to identify a large cohort of children with hearing loss in the first year of life (Yoshinaga-Itano, 2004). Large scale studies indicated that approximately 10% of newborns and infants presented with at least one risk factor (Mahoney & Eichwald 1987; Mason et al., 1997), but this group only accounted for 45 to 50% of infants with congenital or early-onset hearing loss (Chu et al., 2003; Davis & Wood, 1992; Watkin et al., 1991).This led to the JCIH producing a 1994 position statement in which it changed its goal of targeted high-risk screening and endorsed "*the goal of universal detection of infants with hearing loss as early as possible. All infants with hearing loss should be identified by three months of age, and receive intervention by six months of age*" (JCIH, 1994).

Risk indicators are still however recommended for continued surveillance of infants and toddlers and as an intermediate solution where UNIHS is not immediately feasible (Olusanya, Luxon, & Wirz, 2005). Lists of these risk indicators have been published in the Year 2007 JCIH position statement. Surveillance of infants will require that caregivers at antenatal levels of care are informed of the risk factors and that these are clearly and accurately recorded on Road to Health Charts.

1. Risk-based screening (Birth through 28 days of age)

The list of risk factors specified by the JCIH year 2007 position statement is recommended for use in risk-based screening. In addition to this list, maternal HIV has been specified as a contextual risk factor for South Africa (Swanepoel, Hugo & Louw, 2005b). HIV has become a pandemic in South Africa with 2 in every 10 adults infected and a higher prevalence amongst females (UNICEF, 2005). Approximately 17% of women between 15-49 years of age are HIV positive (Statistics South Africa, 2013).

Although a study conducted in Nigeria found that newborns of HIV positive mothers were at no greater risk for sensorineural hearing (Olusanya, Afe & Onyia, 2009), other studies consider children born of HIV/AIDS infected mothers are at increased risk for hearing loss. This increased risk could be linked to significantly lower birth weight, increased vulnerability for acquiring infections such as meningitis, viral encephalitis and cytomegalovirus (Spiegel & Bonwit, 2002). The direct effect of HIV exposure in-utero on newborn and infant hearing has not yet been established. In light of the widespread prevalence of maternal HIV, this requires further investigation in South Africa as a matter of priority.

Sensorineural hearing loss may be caused directly as a result of viral infection causing damage to the inner ear (Yoshikawa et al., 2004; Gold & Tami, 1998; Chakraborty, 2004). Viral infections may also damage the upper respiratory tract; acute otitis media and myringitis may follow with a conductive hearing loss because of the damage (Newton, 2006; Yoshikawa et al., 2004; Gold & Tami, 1998). This greater risk for developing middle-ear infections, which leads to a conductive hearing loss, may even ultimately result in a sensorineural hearing loss (Bam, Kritzinger & Louw, 2003; Matkin, Diefendorf & Erenberg 1998; Parving, 2002; Singh et al., 2003). A pilot study investigating hearing screening outcomes in a group of paediatric patients attending an HIV/AIDS clinic at a hospital in Gauteng indicated that otitis media was found to be the most prevalent cause of hearing loss in these HIV infected patients (Khoza-Shangase & Turnbull, 2009). Therefore, maternal and/or infant HIV infection presents a risk for congenital, early-onset and late-onset or progressive hearing loss. It has therefore been added to the list of risk indicators for risk-based screening and risk-based surveillance.

The list of risk factors for hearing loss in South Africa requires further modification through relevant research to ensure appropriate, early referrals among relevant medical professionals and audiologists within a risk-based hearing screening programme (Kanji & Khoza-Shangase, 2012). Hence, other risk

factors should be investigated as these may vary across contexts and different time periods (Olusanya, Luxon & Wirz, 2004a). It is therefore recommended that these risk factors be used as a guideline, with the ideal risk-based screening programme ensuring hearing screening of all NICU graduates and/or those discharged from high care wards. The recommended list of risk indicators for South African risk-based screening is listed in Table 7 below.

Table 4: Risk indicators for risk-based screening in South Africa

a) *Parental or caregiver concern regarding hearing, speech, language, and or developmental delay.
b) *Family history of permanent childhood hearing loss (first cousin or closer to baby)
c) All infants with or without risk factors requiring neonatal intensive care for *greater than 5 days*, including any of the following: *Extracorporeal membrane oxygenation (ECMO), assisted ventilation, exposure to ototoxic medications (gentamycin and tobramycin) or loop diuretics (furosemide/lasix). In addition, regardless of length of stay: hyperbilirubinemia requiring exchange transfusion.
d) In-utero infection such as *cytomegalovirus (CMV), herpes, toxoplasmosis, rubella
e) Craniofacial anomalies, including those that involve the pinna, ear canal, ear tags, ear pits, and temporal bone anomalies.
f) Physical findings, such as white forelock, that are associated with a syndrome known to include a sensorineural or permanent conductive hearing loss.
g) *Syndromes associated with hearing loss or *progressive/late-onset hearing loss, such as neurofibromatosis, osteopetrosis, and Usher syndrome; other frequently identified syndromes include Waardenburg, Alport, Pendred, and Jervell and Lange Nielson.
h) *Neurodegenerative disorders, such as Hunter syndrome, or sensory motor neuropathies, such as Friedreich's ataxia and Charcot-Marie-Tooth syndrome.
i) *Culture-positive postnatal infections associated with sensorineural hearing loss, including bacterial and viral (especially herpes viruses and varicella) meningitis.
j) *Head trauma, especially basal skull/temporal bone fracture that requires hospitalization.
k) *Chemotherapy
l) *Maternal and/or infant HIV infection
m) *Recurrent or persistent otitis media with effusion for at least 3 months

For a screening protocol targeting bilateral hearing loss:

- *Infants with a unilateral refer result are at risk for a progressive bilateral hearing loss

* ***Denotes the risk factors that are of greater concern for delayed onset/progressive hearing loss***

Compiled from the JCIH (2007 & 2008) with additional risk indicators based on SA contextual infections and screening protocols targeting bilateral hearing loss

2. Continued surveillance

Not all infant and childhood hearing losses will be detected in the newborn. A strategy to identify acquired, late-onset, and progressive hearing losses as early as possible is an important part of a newborn hearing screening programme. These hearing losses will not be identified by newborn hearing screening and can be the result of (a) an acquired loss later in life after a traumatic event such as infection, ototoxic therapy, or chemo therapy, (b) a loss of insufficient severity to be detected by a screening procedure at birth but which progresses as the child grows, (c) a genuine late-onset loss that develops without any obvious causative factor (Fortnum, 2003) or (d) an auditory neuropathy spectrum disorder that may be missed in certain testing protocols (Watkin & Baldwin, 2011). As UNIHS programmes continue to develop, it will become possible to determine the proportion of hearing losses in infants that are truly congenital and those that occur postnatally (JCIH, 2007). This will allow for accurate and comprehensive infant hearing screening programmes that identify congenital and delayed-onset or progressive hearing losses efficiently. Initial reports, based on cohorts mostly from the 1970s and 1980s in Europe, indicate that 14.5% to 27.9% of hearing-impaired children exhibit these types of hearing losses. The large range probably reflects differences in definition (Fortnum, 2003). Reports also indicate a higher prevalence of such disorders among NICU-discharged infants (Kawashiro et al., 1996; Robertson et al., 2002). A large cohort study in England reported an overall prevalence of 1.49/1000 for all permanent childhood hearing impairment in children with risk factors who pass newborn hearing screening (Wood, Davis & Sutton, 2013). Watkin and Baldwin (2011) found that as many as 51% of children with a permanent hearing impairment in their study required identification through ongoing surveillance. Some of these children had moved into the district in childhood and missed their initial hearing screening, whilst others had late onset, progressive or acquired hearing loss and several had hearing loss types or configurations that were not identified by their initial screening.

Delayed-onset hearing losses require protocols that will ensure early identification despite having passed a newborn hearing screen. The JCIH marked the risk factors on their list that are of greater concern for delayed-onset or progressive hearing loss and recommended that infants with those risk factors should be monitored (JCIH, 2007). HIV has been added to the list of risk factors for acquired, late-onset or progressive hearing losses in South Africa. As stated in the previous section, infant HIV is common in Africa and has been linked to acquired hearing loss (Sowunmi, 1997; Chukezi, 1995; Yoshikawa et al., 2004; Gold & Tami, 1998; Chakraborty, 2004). In addition, programmes implementing a screening protocol targeting bilateral hearing loss, must consider unilateral hearing loss as a risk factor for development of bilateral hearing loss. Increasing evidence on initial unilateral losses or unilateral refer screen results indicate a high incidence of late-onset and progressive hearing loss in the other ear leading to bilateral hearing loss (Murphy & Radford, 2006; Brookhouser, Worthington, & Kelly, 1994). Infants presenting with unilateral refer results should therefore be considered as at-risk for bilateral hearing loss.

Studies and evidence reviews examining the effectiveness of targeted surveillance of babies who pass the newborn hearing screen but have risk factors, led to new recommendations (Wood et al., 2013; Molloy, Wake, Poulakis, Barker & Goldfeld, 2014):

1. Targeted surveillance are recommended for young children who pass their newborn hearing screen but have one of the following risk factors for postnatal hearing loss:
    - Down's syndrome
    - Other syndromes known to be associated with a hearing loss (e.g. Treacher Collins syndrome, Pendred syndrome, CHARGE syndrome)
    - Craniofacial anomalies
    - Congenital infection (e.g. toxoplasmosis, rubella, CMV)
    - *NICU with refer in both ears at OAE and pass in both ears at AABR *(*Applying this risk factor will depend of the protocol that is followed. Australian programmes following an AABR*

only protocol dropped this risk factor from the list)

These children should be referred for behavioural audiological assessment around 8 to 10 months of age and surveillance protocols should be developed in line with the typical ages of onset provided in *table 8*. This information should be available to personnel involved in the screening and monitoring of at-risk infants. Molloy et. al. (2014) highlight that successful implementation of such surveillance will require sufficient population coverage, clear definitions of risk factors, systems to maximise diagnostic appointment uptake, and systems to track and follow children through early childhood. South Africa is still in need of such electronic tracking and monitoring systems to support surveillance.

Important to consider is the fact that ECMO has been removed from the list despite some evidence of a higher risk of progressive and late-onset hearing loss in survivors (Wood et. al., 2013). The decision was made based on very limited screening sites offering ECMO and well established referral protocols being in place for sites who do provide ECMO (Wood et. al., 2013). South African screening programmes are urged to investigate the use of ECMO in their areas of reach and to decide on follow up protocols accordingly.

Targeted surveillance for children who pass the screen and have other risk factors has been deemed ineffective (Wood et. al., 2013; Molloy et. al., 2014). Important to note is that this does not mean there is no risk associated with these factors, and that parental or professional concern about hearing should always lead to a referral to Audiology.

2. Audiologic services should be readily available for diagnostic testing of children with possible hearing loss referred due to a specific risk factor or concern occurring later (irrespective of newborn hearing screening result):
    - Parental or professional concern about hearing loss or development (especially in language and related abilities)
    - Illnesses or events during childhood known to cause hearing loss (e.g. confirmed or strongly suspected bacterial meningitis or meningococcal septicaemia, temporal bone fracture, severe unconjugated hyperbilirubinaemia).
    - Ototoxic drugs – responsibility for monitoring lies with the Paediatrician/medical team and referral should be made at their discretion

The provision of post-neonatal pathways remains essential in order to identify hearing loss in early childhood (Watkin & Baldwin, 2011). Reactive care pathways in response to parental or professional concern, as well as school entry hearing screening, are recommended as the most effective ways to identify acquired hearing loss (Watkin & Baldwin, 2011). Parental concern about an infant's hearing, or development of auditory or vocal behaviour should always be taken seriously. A South African study emphasises the call for efficient and swift action in response to maternal suspicion of hearing loss – Störbeck and Young (2016) highlight that this can substantially reduce the age of identification.

A recommendation is made that at-risk infants be monitored by their caregivers as well as primary healthcare providers for communicative development. This will require trained personnel to inform and empower caregivers to carefully monitor their child's hearing ability and communicative development against the milestones for normal speech and language development. Mothers/caregivers should be encouraged to report any concerns/suspicions whilst healthcare providers should act promptly when any concerns/suspicions are raised.

Table 5: Ages of onset of progressive hearing loss in children

Age Band	Aetiology
0-5 years	• Autosomal Recessive • X-Linked • Jervell & Lange-Nielsen Syndrome • Perinatal Events • Congenital Cytomegalovirus • Congenital Rubella Mucopolysaccharidoses
5-10 years	• Autosomal dominant • Osteogenesis imperfecta • Alport Syndrome • Alstrom Syndrome • Marshall Syndrome • Noonan Syndrome
10-20 years	• Otosclerosis • Usher Type 3 • Mitochondiral • Down Syndrome • Turner Syndrome • Norrie Syndrome • Congenital Syphilis • Autoimmune • Noise
Any age	• Bacterial Meningitis • Ototoxic medication • Widened vestibular aqueducts • Tumours • Trauma

Source: Commonest ages of onset of Progressive Hearing Loss in Children (Lucas, 2009 In Newton, Pp. 63)

E. Protection of Infants' and Families' Rights (Principle 5)

An ethical obligation resides with all professionals involved with EHDI programmes to protect the rights of the infants and families. Each institution or department involved in the EHDI process is responsible to maintain and respect these rights. According to the JCIH (2007), these rights include access to UNIHS, information in a language the family can converse in, choice, and confidentiality. The information to convey includes: 1) the purpose of the screen; 2) likelihood of positive and negative findings, 3) possibility of false positive and false negative findings; 4) uncertainties and risks attached to the process; 5) any significant medical, social, or financial implications to any component of the EHDI process; 6) availability of follow-up, counselling and support services (General Medical Council, 1999; Olusanya, Luxon & Wirz, 2004b). The goal of informed choice is not to obtain parental consent, but to ensure that the decision to accept or decline is made from comprehensive information on the consequences of the possible courses of action (Olusanya, Luxon & Wirz, 2004b). Information should be provided in consumer-oriented language by professionals who are

knowledgeable in infant hearing loss, the identification, diagnosis, and intervention process. Informed consent must be obtained before conducting any procedure as a basic legal requisite for disclosing medical information. Failure to comply is unethical and undermines the quality assurance of the EHDI process (Olusanya, Luxon & Wirz, 2004b). The family has the right to choose a preferred communication mode protected by the South African Constitution. The family has the right to confidentiality of all screening, assessment and intervention results which requires that infant and family information not be accessible in unsecured formats. Effective information management assures proper communication and confidentiality of EHDI information (JCIH, 2007). All information management should be in alignment with the Protection of Personal Information Act.

In order to provide informed choice regarding intervention with children diagnosed with hearing loss, families are to be provided with access to comprehensive, unbiased and evidence-based information on the full range of options. Information provided should: be evaluative, providing insight into the risks and benefits of each choice; allow the family to gain understanding regarding all options including options not currently available to the family; provide an understanding of the benefits and risks of any option in the context of the particular family; support families in reaching their own decisions (Young, Hunt, McCracken & Tattersall, 2006).

F. Information Infrastructure and quality monitoring (Principle 6)

1. Data Management

A national information infrastructure is vital to enable management of an EHDI programme in hospitals and community settings and to provide data for audit and service development decisions (Waddell, 2006). Development of a national database is recommended to collate data in a uniform manner. Only such an infrastructure is able to facilitate effective communication between screening and intervention services. Uniform information systems are currently in use in the United Kingdom, US and Australian states. As recommended by the JCIH, this requires a standardised methodology, reporting system, and programme evaluation criteria. This type of information management will serve various critical priorities including the improvement of services to infants and families; assessment of screening, evaluation, and intervention quality; compilation of data on demographics for neonatal and infant hearing loss which is currently unavailable for South Africa. A review of each of these priorities is provided in the JCIH Year 2007 position statement.

The information system must be integrated into existing systems and should maintain a record for each birth with screening, including any rescreening or other assessments undertaken. The record can include risk factor data as well as information on referral to early intervention. Individualised records assure that each infant receives all needed care. These recording tools should be standardised with agreement on the type of data to collect and at which level (see Section 7 on Benchmarks and quality indicators). The aggregate information from each District Health level can be integrated at each province and finally be viewed at a national level. Each District Health Department must report the number of live births and the number of newborns and infants that have been screened for hearing loss during the birth admission and first immunisation visit; the number of birthing hospitals or clinics in each district; the number of hospitals and/or PHC clinics with newborn hearing screening programmes and the type of hearing screening programme implemented (universal or risk-based). Other information should be reported according to the quality indicators specified by the Professional Board for Speech, Language and Hearing Professions, and a national database should be developed.

2. Loss to follow-up

Loss to follow-up is a current challenge in newborn and infant hearing screening programmes worldwide. Findings from studies of existing programmes should be used to assist in predicting barriers and potential solutions when developing programmes. High default rates have been reported as a significant challenge in a community-based screening programme in Nigeria, despite efforts to minimise barriers (Olusanya, Wirz & Luxon, 2008).Barriers to successful follow-up include: (1) lack of service-system capacity, including lack of screening equipment, paediatric audiologists, early intervention services and family support programmes; (2) lack of provider knowledge, linked to lack of protocols, expertise and knowledge of intervention services; (3) challenges to families in obtaining services, due to difficulties such as lack of transportation, costs and language barriers, and (4) information gaps, including lack of effective data management systems (5) lack of caregiver knowledge regarding initial screening outcome and recommendations for follow-up. Some considerations for addressing this include: improving data systems to support surveillance and follow-ups; ensuring that all infants have a medical home with coordinated care; building capacity beyond identified providers; developing family support services and promoting the importance of early detection; ensuring effective communication between professionals and caregivers (Scheepers, Swanepoel & Roux, 2014; Shulman, Besculides, Saltzman, Ireys, White & Forsman, 2010).

VIII. TRAINING AND IMPLEMENTATION GUIDELINES

The HPCSA Position Statement on Early Hearing Detection and Intervention (EHDI) provides evidence-based support and guidelines regarding universal infant early hearing detection and intervention programmes in South Africa. During the most recent review of the position statement, the assigned task team found a need to provide further recommendations on the practical implementation of EHDI in South Africa. This section aims to address this need by providing guidance on the following:

1. **Practical implementation guidelines**
2. **Training model for screening**
3. **Training curriculum**
4. **EHDI management structures, roles and responsibilities**
5. **Implementation considerations**
6. **Future recommendations**

1. Practical Implementation Guidelines

Despite the release of the EHDI position statement in place in 2007, implementation and roll-out has been slow. Some practical guidelines are offered to assist provinces, hospitals or districts to initiate EHDI services. A strong recommendation is made to develop integrated models of service delivery, embedding the components of EHDI into existing structures with redefined roles and responsibilities. During the planning phase it is important to keep the entire EHDI model in mind as no one of the individual components can exist without the other. Table 9 gives an overview of the EHDI model as described by the JCIH (2007), with adaptations for the South African context.

Table 6: Components of EHDI

WHAT	HOW	WHO
Screening (< 4-6 weeks)	OAE	Trained screeners Audiologists to manage/train/screen
	AABR	
Diagnosis (< 3-4 months)	Diagnostic audiologic assessment	Audiologists
	Otological assessment	Otorhinolaryngologists
Intervention (< 6-8 months)	Amplification (Hearing Aids/ Cochlear Implants)	Audiologists / Otorhinolaryngologists
	Early intervention (Family-centred / Communication modes / Language)	Speech-Language Therapists / Early Interventionists / Audiologists / Parent Guidance Facilitators etc.

A '*needs assessment and planning guide*' is offered as Appendix A as a tool to guide programme development. Identifying key stakeholders and planning for all the phases (i.e. screening, diagnosis and intervention) is essential to success.

Audiologists are urged to take up the role of managing/coordinating screening programmes instead of doing the screening themselves. The audiologist is key in: developing the protocol and referral pathways; guiding implementation; training and mentoring of screeners; assuring quality control; follow-up management and as liaison with stakeholders. Importantly, audiologists are required to fulfil the diagnostic and intervention aspects of the EHDI process. To date, no guidelines exist in South Africa to ensure uniform training of screeners. Sub-section 2 and 3 of this section propose a training model as well as curriculum for screeners to assist in this regard.

2. Training Model for Screening

With the vision of national implementation of universal infant hearing screening, a train-the-trainer model is suggested. This should facilitate a uniform standard of screener training, while allowing for relatively easy and widespread implementation. It is envisaged that a national train-the-trainer curriculum be developed, linked to and overseen by the national EHDI programme. As discussed in sub-section 4, provincial coordinators from the public and private sector can then be trained to present the train-the-trainer programme to area managers in their provinces. Figure 1 provides a visual representation of the model.

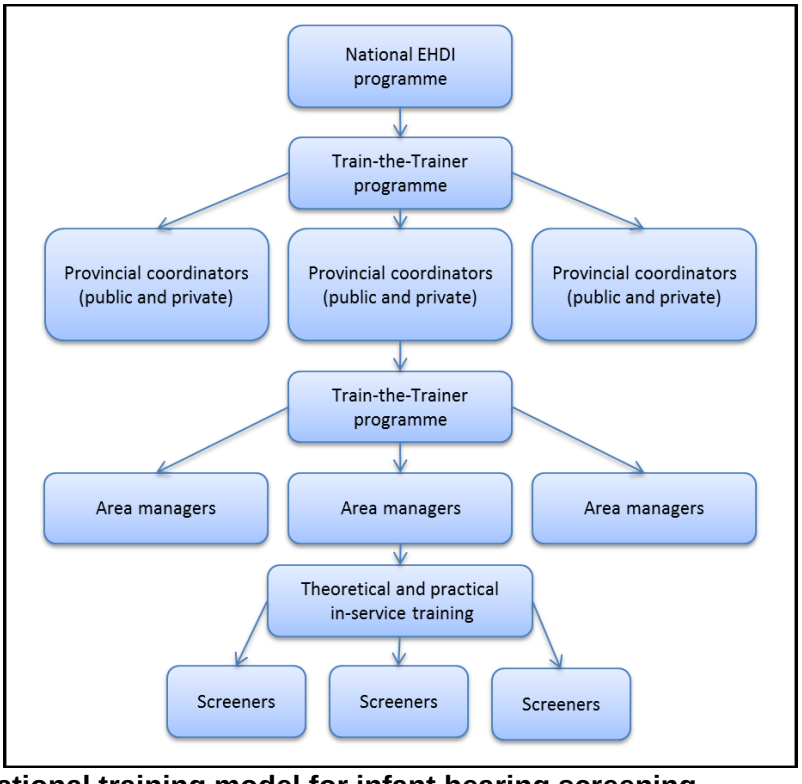

Figure 1: Proposed national training model for infant hearing screening

This model should not be interpreted to take away the responsibility for implementation of the programme and the training from the management line function, and the formalised Human Resource Units in provincial Departments of Health. It is crucial that at district level, district directors and their Human Resource Development units be held accountable for this.

It is further recommended that a database be created where trainers and screeners can be logged once they have successfully completed their training. Such a database can also assist area managers to know when refresher training and competency checks are due.

3. Training Curriculum

The EHDI Position Statement, as well as international guidelines, recommends that non-audiologists be trained to conduct infant hearing screening. The specific personnel required may vary across contexts and provinces, dependent on the most suitable and accessible personnel.

3.1. Rationale for training of screeners

The training of non-audiologists as screeners may assist in addressing the manpower shortages in the Audiology profession. These shortages have been reported in literature as one of the challenges to the successful implementation of EHDI in South Africa. More specifically, the use of screeners may assist in improving coverage rates required to achieve UNIHS and will allow more time for audiologists to focus on the diagnosis and intervention for newborns and infants diagnosed with hearing loss.

3.2. Training curriculum

A training curriculum has been developed and is included as Appendix B. It sets out the intended learning outcomes together with the needed skills, attitudes and key areas to be covered in the content. Furthermore, it suggests teaching and learning activities and guidelines for assessment. Theoretical as well as practical in-service training components are necessary.

3.3. Training materials and resources

Audiologists have overall responsibility for training the trainers and screeners. Trainers can use the provided curriculum to develop their own training. Alternatively, permission has been obtained from the National Centre for Hearing Assessment and Management (NCHAM) of the Utah State University to use their training programme. It is a comprehensive training curriculum and has been evaluated by the 2015 task team to ensure adherence to the curriculum set out in Appendix B. As NCHAM is an American organisation, the training programme only showcases hospital-based screening and contains some terminology specific to their context. However, the principles are universal and presented in a well-balanced interactive way. A pre-training PowerPoint presentation has been developed to provide some contextualisation for the South African context (see Appendix C) and suggestions for future customisation of the NCHAM programme have been noted. It is suggested that customisation of the NCHAM programme only be considered after an initial pilot of the existing programme.

The NCHAM 'Newborn Hearing Screening Interactive Web Based Training Curriculum' for screeners is available online [http://www.infanthearing.org/nhstc/] or could be ordered in DVD format. The online version offers two options:

- Certificate version (sign in through the Moodle learning system): http://ncham-moodle.eej.usu.edu/moodle/login/index.php
- Non-certificate version (immediate access): http://www.infanthearing.org/infant_screening_course/index.html

The NCHAM training curriculum also includes sample scripts for counselling/communicating results which can be printed as hand-outs.

Additionally, practical 'hands-on' equipment and context specific training is required. This is normally done one-on-one, in the environment where screening will be done. The screener first observes the trainer for a few screens and then engages in 5 to 10 supervised screens (per technology). Also included is a *practical training and competency checklist* intended to guide trainers through the practical training component (see Appendix D).

3.4. Assessment materials and methods

The attached screener curriculum provides suggested assessment criteria which can be used as a guideline. Alternatively, if the NCHAM curriculum is used, an option is offered to complete an online assessment post completion of the course. A pass criterion of 80% is required in order to obtain a certificate issued by NCHAM.

Once the practical training has been completed the provided *competency checklist* can be completed to guide the trainer in granting the screener permission to start screening independently (see Appendix D).

3.5. Qualification and registration of screeners

A national database to log all trainers and screeners that have successfully completed their training will be created. Until such time, it is the responsibility of the screening programme manager (area manager) to keep a log of all screeners together with the date on which they were deemed competent.

3.6. Ongoing support and refresher courses

Regular support and quality assurance visits are necessary. Initially, the screener will require frequent support visits, until a level of independence has been achieved. Research has indicated the need for regular refresher training which may vary between four and six months depending on how regularly the screener performs screening. If a screener has not screened for a period of six months or more, screening competency will have to be re-obtained.

4. Management structures, roles and responsibilities

It is essential that all EHDI programmes have a management structure as well as clinical governance systems to ensure accountability and sustainability of the programme. It is recommended that national governance structures be developed in South Africa (inter-sectorally) and that an independent advisory group of experts (reference group), who are not involved in the programme, be established to guide development.

Section VI 'Roles and Responsibilities' in the Position Statement provides an overview of general roles and responsibilities related to EHDI programmes. Below are roles and responsibilities of the newly proposed implementation role-players:

4.1. Provincial coordinators

4.1.1. Roles/responsibilities:

- It is recommended to have a minimum of one person representing the private sector and one representing the public sector in each province
- Provincial coordinators will report to the national EHDI programme
- Provide train-the-trainer programmes to area managers
- Liaise with area managers to implement the programme and to obtain statistics for reporting and monitoring purposes

4.1.2. Candidacy:

- Audiologists

4.2. District or Area managers

4.2.1. Roles/responsibilities:

- Any individual who is managing a screening programme at a screening site
- Role may include liaison with managers, negotiating of space, staff to be trained
- Placing of orders for consumables, new equipment, repairs, calibration
- Responsible for training screeners, quality management of their programmes and compiling accurate statistics for provincial coordinators
- Tracking of babies and liaising between screening, diagnostic and intervention services
- Responsible for compiling and updating referral pathways specific to the site
- Responsible for obtaining training and resource packs for screeners

4.2.2. Candidacy:

- Audiologists
- Over time, this role could evolve to include individuals with an interest and experience in newborn and infant hearing screening and could include rehabilitation managers or maternal and child health managers

4.3. Trainers

4.3.1. Candidacy:

- At this early stage in the development of EHDI in South Africa, it is recommended that only Audiologists would be appropriate newborn hearing screening trainers
- Over time, this may broaden to include other professionals with sufficient experience and training in the area. In many countries, screeners with extensive experience can become trainers.
- Those who wish to become trainers for the screening component of EHDI programmes will be required to complete a train-the-trainer course once it has been developed and implemented through the provincial coordinators. Until such time, audiologists wishing to train screeners should ensure that they comply with the guidelines set out in this section.

4.4. Screeners

4.4.1. Candidacy

- There are no pre-requisite qualifications for this role. Preference may be given to persons who have experience in handling young babies and/or experience working in the healthcare industry.

4.4.2. Screener profile and characteristics

- Good oral and written communications skills
- Cultural sensitivity and proficiency in the language/s of the area
- Basic computer literacy and data entry skills
- Good interpersonal skills and professional demeanour
- Good organisational and time management skills
- Attention to detail
- Ability to work under pressure
- Patience and empathy
- Ability to acquire the required skills to operate screening equipment and conduct hearing screens according to a protocol

4.4.3. Job description

- The role of the hearing screener is to work as a member of the larger EHDI team in offering a hearing screening service to newborns/infants according to the specific programme's protocol. This involves administering screens through the operation of automated equipment and recording the data as prescribed. This role also includes providing accurate information to parents/caregivers regarding the screening process and results.

5. Implementation considerations

The design of the programme should include context specific hearing screening protocols and referral pathways, supervision of new screeners, appropriate record keeping methods, quality assurance measures and relevant resources.

5.1. Context-specific customisation

The implementation of these guidelines will be dependent on the newborn/infant hearing screening models adopted in different provinces and contexts. For example, some provinces may adopt a community-based screening model at immunisation clinics or obstetric units, whereas others may adopt a hospital-based screening model or a combination of both. Customisation will also be required for different contexts within provinces, such as rural and urban. There is therefore a need for the implementation of training to be customised, with the use of these guidelines as a foundation.

5.2. Pilot programmes

Provinces/hospitals/districts implementing EHDI programmes are urged to start pilot programmes at selected sites. These pilot programmes can be developed with existing knowledge as their basis and will provide opportunity to customise the model according to the specific context and needs. Once a programme starts reaching the benchmarks and good synergy has been achieved between the three components (screening, diagnosis and intervention), the comprehensive EHDI programme can be rolled out. Pilot programmes should not last longer than 2 years, and should not be used as a reason for not rolling out the programme across the services.

5.3. Supervision structures

It is essential to have protocols embodied within management structures.

In the absence of the above-mentioned management structures, it is recommended that provincial coordinators are nominated. These provincial coordinators should provide support to area managers and ensure adequate supervision of screeners.

5.4. Database

Development of a database is a key element to programme success in order to ensure tracking of newborns and infants who have been enrolled in the newborn hearing screening programme. The database will further assist in obtaining more accurate prevalence rates of newborn and infant hearing loss for the South African context as well as provide information on the age of hearing screening and age of diagnosis of hearing loss. The national database must be created and integrated into the Health Information Systems in the private and public sectors at Provincial and National levels. This database should be effectively utilized in service planning and resource allocation.

In the interim, in the absence of a national database, it is recommended that the provincial coordinators create and circulate an Excel template for data collection, which should be compiled or supervised by the area manager and sent to the provincial coordinator on a monthly basis. Recorded data may include a summary of the number of babies born at the site (if available), the number of newborns/infants screened, the number of newborns/infants who referred the hearing screening, and the number of newborns/infants who required diagnostic evaluations.

Confidentiality and protection of private information should be ensured when data is submitted provincially and nationally. It is recommended that patient information is backed up daily to protect against loss of information.

5.5. Integration of training into parallel programmes

It is recommended that the hearing screening training module be integrated into training programmes of other individuals in the healthcare sector who may have contact with infants, caregivers or screening programmes. This includes for example, training at nursing colleges and training of mid-level workers.

5.6. Referral pathways

These will be dictated by individual contexts. Each area manager must have a referral pathway specific to the site. The referral pathway should include sites that are equipped with the necessary equipment to conduct diagnostic assessments as well as sites that have trained staff that can provide necessary early intervention. The chosen sites within the referral pathway should be in alignment with the levels of service delivery.

5.7. Quality indicators

In order to ensure improvement in the quality of the programme, progress toward, and achievement of UNIHS, regular monitoring is necessary and can be conducted through detailed documentation. It is recommended that the quality indicators as set out in Table 6 be utilised to guide implementation of an EHDI quality assurance programme.

The JCIH recommend monitoring on a monthly basis in order to measure the progress of the programme against the expected outcomes.

5.8. Recording

Recording of screening results is compulsory, and should also be included in the Road to Health Card of every child.

6. Further recommendations

6.1. Creation of management structures

It is crucial to the success of EHDI in South Africa that management structures are created and coordinators appointed to oversee this process. It is suggested that the HPCSA assist in lobbying for the creation of such structures and that the Department of Health facilitate the creation of posts for provincial coordinators, area managers and screeners.

6.2. Scope of practice

It is suggested that the HPCSA includes hearing screening within the scope of practice documentation for mid-level workers and any other healthcare workers who may be involved in hearing screening. It is also suggested that the HPCSA make a recommendation to the Nursing Council to include screening in nurses' scope of practice.

6.3. Inclusion of diagnostic, amplification and intervention protocols for EHDI

Whilst great emphasis is placed on newborn/infant hearing screening within the HPCSA Position Statement, it is important to note that without implementation of diagnostic assessment and intervention (amplification and aural habilitation), EHDI programmes will not be a success.

6.4. Information, Education and Counselling (IEC) Resources

It is recommended that the HPCSA and National Department of Health should work together to create and translate IEC materials like pamphlets and brochures to ensure provision of culturally and linguistically relevant information to caregivers regarding newborn/infant hearing screening and intervention for children with hearing loss. Provision of written information post diagnosis of hearing loss is essential to support families/carers in this sensitive time.

6.5. Posts and Training

- In order for successful national implementation of EHDI to take place, there will need to be large-scale creation of posts for screeners, trainers and coordinators; and management structures need to be created.
- Training institutions should provide audiologists with the necessary skills to meet the requirements of managing newborn and infant hearing screening programmes (i.e. shift in roles and responsibilities from a clinical to managerial role).
- In the long-term, trainers of screeners will not need to be qualified audiologists. Personnel who will fulfil the role as trainers will be required to attend a train-the-trainer course, which would need to be developed once the initial role out of EHDI is underway.

6.6. Endorsement

It is crucial that other professions like Paediatricians, ENT specialists, Family Physicians, Nurses, Social Workers and more should support this approach formally.

IX. FUTURE DIRECTIONS

In 2005, 278 million people with permanent disabling hearing loss contributed to the global burden of disease on individuals, families, communities and countries (WHO, 2005). Two thirds of these live in developing countries and 1 in every four are of early childhood onset (WHO, 2005). The significance of this health care and socioeconomic burden in childhood and its amenability to early intervention has led to revolutionary growth in newborn and infant hearing screening programmes in developed countries around the world (Morton & Nance, 2006). Infants with hearing loss in developing countries however, especially those in Africa, do not share these prospects of equal opportunities with hearing peers through EHDI programmes since an extreme dearth of early identification programmes exist (Olusanya et al., 2007). This is also true of South Africa, despite having a more robust health care infrastructure compared to other African countries and being the only country on the continent training audiologists. South Africa therefore has the opportunity and the moral obligation to invest in its infants with hearing loss through the implementation of widespread EHDI programmes and to take the lead in assisting other countries in Africa to provide early intervention for infant hearing loss.

Developments in clinical audiological testing should be considered when developing clinical test batteries to identify hearing loss. For example, Wideband Absorbance/Reflectance Tympanometry shows promising potential to replace conventional tympanometry in evaluating middle ear function (Liu, Sanford, Ellison,

Fitzpatrick, Gorga & Keefe, 2008). Hearing screening protocols also need to be reviewed and adapted based on evidence-based findings. There is an international trend to move toward a two-stage AABR-screening protocol. Additional consideration should be made in terms of reviewing technical specifications of audiological screening measures, as well as exploring the minimum pass/refer criteria.

It is recommended that an aetiological investigation protocol be created to guide aetiological investigations into PCEHL. It would be appropriate for this to be driven by an otorhinolaryngologist and could be guided by existing protocols such as the United Kingdom National Health System protocol.

Developments in molecular testing and identification of genetic contributions to hearing loss are an important future direction for infant hearing screening. The majority of hearing losses are attributed to genetics with an estimated contribution of 68% of congenital hearing losses and 54% for hearing losses at 4 years of age in the USA (Morton & Nance, 2006). Finding genes responsible for syndromic and non-syndromic hearing loss has been very successful with 110 chromosomal loci and at least 65 genes already identified (Morton & Nance, 2006). Moving beyond the detection of hearing loss to the identification of its cause has many potential benefits, including disease prevention, improved management, improved interpretation of the results of early intervention and the psychological benefits of understanding the true nature of the loss (Morton & Nance, 2006). Another important and more immediate advantage of genetic screening is the identification of infants at-risk for late-onset hearing loss (Morton & Nance, 2006; NHS, 2006). Despite prevailing challenges and limitations, the rapidly increasing use of diagnostic molecular testing for all infants is becoming the developed world standard of care with tests for certain genetic forms of deafness already available (e.g. GJB2 deafness and mitochondrial A1555G mutation) (Morton & Nance, 2006).

Once the EHDI policy has been accepted, the implementation should be in phases including some pilot projects. This should be subjected to formal research in order to record and facilitate the implementation of consistent, evidence-based screening programmes .Pilot UNIHS programmes must be launched in NICU's, well-baby nurseries, 6-week immunisation visits in PHC clinics or postnatal follow-up visits at MOUs according to the benchmarks and quality indicators specified for these contexts in this position statement. Hospital-based pilot programmes will ideally be implemented at University health care complexes. All programmes must be jointly facilitated by the responsible Department of Health agency and research professionals at Universities with expertise in infant hearing loss. These pilot programmes must serve as centres of service excellence and as examples to other hospitals and/or clinics initiating UNIHS programmes. Efforts may also be made to incorporate other newborn/infant screening into the UNIHS programme to ensure a more holistic, integrated approach to screening of the newborn. Once EHDI programmes are established, it is crucial that quality assurance programmes are implemented to ensure an appropriate and uniform standard of care across South Africa.

Research evaluating monitoring and surveillance protocols for infants at-risk for hearing loss but who pass their initial hearing screening would be valuable in guiding the development of contextually appropriate and feasible protocols for South Africa.

Research into costing models form an essential component in order to facilitate the implementation of EHDI in South Africa. These models should include comparison of the cost of implementation versus non-implementation of EHDI.

Appendix A provides needs assessment guidelines for the practical implementation of UNIHS, with the aim of developing integrated models of service delivery, embedding the components of EHDI into existing structures with redefined roles and responsibilities. These redefined roles and responsibilities refer to the shift in responsibility of screening to trained screeners who are trained and managed by audiologists. Practical recommendations and guidelines for training are provided in appendices B, C and D.

Furthermore, important research data concerning the efficacy of screening programmes and the contextual demographics of hearing loss will be generated at these sites towards providing contextual evidence-based data for EHDI in South Africa.

Newborn hearing screening programmes need to be considered as changes are implemented in health care policies in South Africa. The South African government has recently suggested changes within the health care system with the release of the National Health Insurance (NHI) policy paper which specifies the re-engineering of the primary health care services, as well as related pilot programmes that have been rolled out (DoH, 2011).

X. CONCLUSION

EHDI programmes have proved that "*hearing loss need not impede typical development, place an individual at a functional disadvantage, or alter ultimate outcome*" (Herer et al., 2002). It is time that the hearing loss barrier be minimised for children in South Africa, and that the benefits and improvement of quality of life associated with early identification and intervention become a reality for the infants who suffer hearing loss in South Africa. Children with hearing loss are as much part of the future of the country as those with normal hearing and it is through effective EHDI services that the active and equal participation of these children will be secured among their hearing peers to change, influence and direct the future of South Africa.

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Appendix A
Universal Newborn and Infant Hearing Screening (UNIHS)
Needs Assessment and Planning Guide

*This document has been adapted from the original version made available by the Seattle Children's (Children's Hospital and Regional Medical Center)

HPCSA EHDI Task Team, 2018

FACILITY NAME / SCREENING SITE:	
Facility Manager/Contact Person:	
Contact Number:	
E-mail Address:	
Physical Address:	

1. GENERAL INFORMATION	
What is your screening context/platform? (I.e. NICU, well-baby	

nursery, immunisation visits, postnatal follow-up visits, etc.)	
Who will be the programme coordinator and/or administrator?	
How many births occur in your hospital/MOU/area on an annual basis? (or) What is the annual immunisation figure at your clinic (6 weeks, OPV 1st dose)?	
What is the geographical location of your screening programme? (I.e. rural, urban, etc.)	
What are the demographics of the population your programme will serve?	
If your programme will run at a birthing facility - what is the average length of stay for babies born there?	
Does your hospital/facility/district have an audiologist on staff?	

2. INFORMING AND CONSENT	
How will you inform parents/caregivers that their baby will receive a hearing screening?	
How will you obtain consent for the hearing screening? (Is it covered in your hospital's general consent?)	

What if the parents/caregivers refuse the screening?	

3. LOGISTICS	
When will you perform the screening? When will you perform the 2nd screening (for those referring the 1st screen)?	
Where will you perform the screening? Where will you perform the follow-up 2nd screening?	
Who will perform the screening? Who will perform the follow-up 2nd screening?	
Who will train the screeners?	
Who will review problem cases?	
Who will supervise and/or monitor your screening programme?	

How will the screeners receive feedback about the programme?	

4. EQUIPMENT AND SCREENING PROTOCOL	
Will you be screening using OAEs, AABR or both?	
What piece(s) of equipment will you be using? Has it been tested in your context?	
What will your screening protocol be?	
What is the cost per baby for your disposables? What procedures need to be established to allow timeous ordering of disposables?	
What is your back-up plan in case of equipment breakdown or failure?	
Who will be responsible to ensure annual calibration/repairs of equipment? What procedures need to be put in place to allow for this?	

5. COMMUNICATING RESULTS	
Who will inform the family/caregivers of the screening results?	
How will you ensure that proper explanations are used to convey the results of the hearing screening?	
Who will you refer the family/caregivers to if they have questions you (or the screener) are unable to answer about the screening test and/or the results of the screening test?	
How will you inform the baby's physician/nurse/healthcare provider (and future healthcare providers) of the results of the hearing screening?	

6. TRACKING AND DATA MANAGEMENT	
Which record keeping practices will be implemented? (test forms, result stickers, Road-to-Health booklet, file)	
How will the data be managed?	
How will security of data be ensured?	

How will you track the screening results in the infant's medical record?	
How will you ensure that every baby is screened?	
How will you ensure that babies who are transferred to other hospitals/facilities receive a hearing screening?	

How will you ensure that infants, who are referred for a second screening or are missed initially, return for a follow-up hearing screening?	
How will you ensure that infants who do not pass the 2nd screening are scheduled for a diagnostic hearing evaluation with an audiologist in a timely manner?	

7. DIAGNOSTIC FOLLOW-UP AND EARLY INTERVENTION	
Who will you refer to for diagnostic audiology?	
How will you monitor the outcomes of diagnostic referrals?	
How will you monitor infants who are at risk for progressive hearing loss?	

Who are the early intervention points of contact for the area the programme serves?	

8. STAKEHOLDERS AND KEY PARTICIPANTS			
	Name(s)	**Contact number**	**E-mail address**
Paediatrician(s)			
Nurse Manager/Matron/Sister in Charge			
Administrator/Coordinator			
Audiology Dept/Audiologist			
ENT Dept/Otolaryngologist			
Department of Education representative			
District-based clinical support teams/coordinator			

Early Intervention Programme Coordinators			
Family-to-family support groups			
Persons with/parents of children with hearing loss			
Other:			
Other:			
Other:			

9. POTENTIAL STUMBLING BLOCKS	
What potential stumbling blocks may interfere with the success of your programme? (E.g. staff willingness to participate; support of hospital/facility administration; paediatrician support etc.)	

How will you go about addressing these potential challenges? Which strategies could you try to implement?	

Appendix B

EHDI Programme - Hearing Screening Curriculum

A. INTENDED LEARNING OUTCOME	B. SKILLS	C. ATTITUDES	D. CONTENT * MINIMAL DEPTH ** MODERATE DEPTH *** MOST DETAILED	E. TEACHING AND LEARNING ACTIVITY	F. ASSESSMENT
Demonstrate knowledge of principles and rationale for EHDI.	Utilise this knowledge of relevant areas when providing information counselling to caregivers prior to, or at the initial hearing screening. Elicit relevant information from caregivers and demonstrate an awareness of risk factors.	*Patient *Respectful *Professional *Flexible *Assertive *Confident *Advisory *Self-motivated *Empathetic *Reflective *Team player	*Prevalence of hearing loss *Risk factors for hearing loss *Situation in South Africa *Consequences of hearing loss *Importance and principles of EHDI *Positive outcomes of EHDI *Role of screening within EHDI process	Presentation of theoretical material via training session, e-learning or DVD. Observation of a qualified screener conducting one to two screenings per technology used. Approximately five to ten screenings (per technology) under supervision of the trainer. *<***A screening includes the following: pre- and post-counselling to caregivers, preparation for screening, screening the baby, documentation of patient information and screening results, equipment maintenance, infection control as well as appropriate referrals.***	**Theoretical assessment:** pre- and post-training, with minimum of 80% on post-training assessment. **Practical assessment:** Complete 5 to 10 supervised screens and demonstrate competence on all checklist items for a minimum of 3 independent screenings.

Demonstrate a basic knowledge and understanding of the anatomy and physiology of the ear.	Provide appropriate feedback and explanation of screening results to caregivers, incorporating knowledge and understanding of the anatomy and physiology of the ear.		*Overview of the components of the ear and their functions: related to the objective measurements *Awareness that other conditions could impact on screening results	Video or diagrams of the anatomy and physiology of the ear. Demonstration of how this relates to screening equipment.	
Demonstrate knowledge and understanding of available electrophysiological screening measures.	To be able to identify and use the relevant screening measures in various contexts as per the facility's stipulated protocol.		*The importance of objective screening methods *Types of hearing screening - OAE and AABR *Basic understanding of hearing screening measure and underlying physiological process being measured	Demonstration of the site-specific screening technologies/measures used. Discussion of site specific protocol. Presentation of theoretical material via training session, e-learning or DVD. Observation of a qualified screener conducting one to two screenings per technology used. Approximately five to ten screenings (per technology) under supervision of the trainer.	

Ability to conduct a screening according to testing protocols.	Able to perform oto-acoustic emission (OAE) screening and/or automated auditory brainstem response (AABR) screening. Basic computer literacy. Time management. Written and verbal communication. Good record keeping.		**Preparation for screening (charge and check equipment, environmental modifications, administrative aspects, when to screen, inspect baby's ear for malformations) **Evidence-based screening protocols (when to screen, avoiding repeated screenings, when to use OAEs vs. AABR) **Screening techniques (including positioning of baby, probe insertion, probe check, electrode placement, facilitating optimal test conditions) **Operating screening device **Infection control measures **Ethical considerations	Presentation of theoretical material via training session, e-learning or DVD. Observation of a qualified screener conducting one to two screenings per technology used. Approximately five to ten screenings (per technology) under supervision of the trainer.	
Provide pre- and post-screening counselling, recommendations and appropriate referral according to screening protocols.	Good interpersonal skills. Basic counselling skills. Verbal and written communication. Good record keeping. Time management.		**Explanation of test procedure and purpose of screening to caregivers **Explanation of screening outcomes and implications to caregivers ** Standardised	Self-reflection and discussion with trainer regarding counselling skills. Presentation of theoretical material via training session, e-learning or DVD. Observation of a qualified screener conducting one to two screenings per technology used.	

			counselling and referral protocols	Approximately five to ten screenings (per technology) under supervision of the trainer.	
Troubleshoot in the event of challenges encountered during screening.	Good observation skills. Critical thinking skills. Problem solving skills. Good interpersonal skills.		**Possible challenges relating to: State of the child - calm child, swaddling. Screening environment - ways to keep test environment quiet. Equipment placement/faults - applying basic troubleshooting e.g. checking if probe tip is blocked. Available support channels in the event of screening difficulties, when independent troubleshooting efforts are unsuccessful e.g. contacting manager/manufacturer.	Discussion of how to access support in the event of technical difficulties (site-specific). Presentation of theoretical material via training session, e-learning or DVD. Observation of a qualified screener conducting one to two screenings per technology used. Approximately five to ten screenings (per technology) under supervision of the trainer.	

Competent in promotion and prevention activities related to EHDI.	Good interpersonal skills. Basic public speaking skills. Advocacy and lobbying.		*Knowledge of the importance of EHDI, the screening process and referral pathway (as above) *Empower carers with information regarding normal hearing and communication development *Overview of importance of promotion and prevention strategies with caregivers and professionals	Discussion of importance of promotion and prevention strategies. Implement individually or in groups, as site-appropriate.	
Consult and collaborate with relevant EHDI stakeholders with a basic understanding of diagnosis, management and intervention process.	Good interpersonal skills. Consult with audiologist/programme manager when required. Compare screening results against protocol to make appropriate referrals. Communication skills.		*EHDI stakeholders and team members. **Roles and responsibilities of the screener in relation to the EHDI team. **Referral pathways.	Discussion of site-specific referral pathways.	

Administration and data management/record keeping.	Literacy skills. Careful documentation. Understanding of institution-based abbreviations and recordkeeping. Basic computer literacy.		**Test forms *Pamphlets **Record results according to protocol.	Practice the completion of all relevant recording sheets (i.e. test forms, stickers, follow-up registers, statistics sheets, etc.) prior to the commencement of practical training. Presentation of theoretical material via training session, e-learning or DVD. Observation of a qualified screener conducting one to two screenings per technology used. Approximately five to ten screenings (per technology) under supervision of the trainer.	

WELCOME TO THE NEWBORN HEARING SCREENING TRAINING CURRICULUM

Acknowledgements: Thank you to the National Centre for Hearing Assessment and Management (NCHAM), Utah State University for permission to use their training materials

INTRODUCTION

- The training curriculum involves 7 modules
- These training modules have been developed by NCHAM
- Some terms used may therefore be different for the South African context - hence this introductory presentation

DIFFERENCES IN TERMINOLOGY

- The training material refers to the term "hospital". In South Africa, newborn hearing screening may take place in **different contexts**

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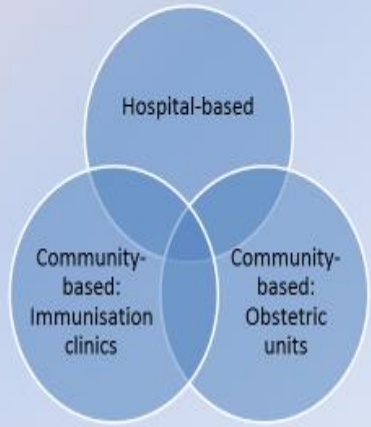

SUMMARY OF POSITION STATEMENT GUIDELINES

Initial hearing screening
- Hospital-based: by 1 month of age
- Community-based: at 6-week immunisation visit or postnatal follow-up visit at obstetric units

Confirmation of hearing loss (Diagnostic evaluation)
- Hospital-based: evaluation before 3 months of age (nearest facility-secondary or tertiary hospital)
- Community-based: before 4 months of age

Early Intervention
- Hospital based: before 6 months of age
- Community-based: before 8 months of age

PROMOTION AND PREVENTION

- As a screener, you will also be responsible for promotion and prevention activities focused around newborn and infant hearing loss.
- These activities play an important role in educating families about childhood hearing loss especially families with a history of hearing loss who need to be involved in monitoring of their babies' hearing.
- They assist in promoting the importance of early identification of hearing loss through newborn hearing screening.
- Promoting healthy hearing is also important for the prevention of illnesses associated with chronic middle ear infections or acquired hearing loss.

ENJOY THE TRAINING AND YOUR NEW ROLE AS HEARING SCREENER!

- Your trainer will provide you with terminology/examples relevant to the screening site at which you will be working.
- Please ask your trainer for clarification if you feel uncertain about any term/component of the training.

Appendix D
Practical Training & Competency Checklist for Hearing Screeners

*Adapted from various sources, see footnote
HPCSA EHDI Task Team, 2018

Screener: _____

Contact number: _____

Facility/Site: _____

Supervisor: _____

Screening technology: OAE ____ AABR ____

Device brand/make: _____

A. Practical training checklist

It is recommended that the screener first observes the supervisor whilst screening one to two babies. The screener is then required to screen five to ten babies under direct supervision. The supervisor writes comments/notes under the different headings to guide the feedback after each screening. If the supervisor is completely satisfied with the competency area, a tick (√) can be made. If a certain scenario (e.g. a bilateral refer result) has not been encountered, the supervisor can create additional scenarios to give the screener opportunity to practice this. A separate form should be completed for OAE and AABR practical screening training in cases where a screener is required to perform both. Five to ten supervised screenings per technology is required.

		Date			**Date**
2	1	**Baby**	Observe	Observe	**Baby**
		Information given (pre-screening			**Information given (pre-screening**
		Infection control			**Infection control**
		Positioning of baby			**Positioning of baby**
		Handling of equipment			**Handling of equipment**
		Information given (post-screening			**Information given (post-screening**
		Administration			**Administration**
		Right ear result			**Right ear result**
		Left ear result			**Left ear result**
		Action plan			**Action plan**

	3									
	4									
	5									
	6									
	7									

	8									
	9									
	10									

B. <u>Competency checklist</u>

Once the practical training and supervised screens have been completed, the supervisor and screener can complete the competency checklist together to finalise the practical training component.

	Tick (√)
1. Demonstrates knowledge of newborn and infant hearing screening and infant hearing loss	
2. Demonstrates competency in infection control precautions	
3. Demonstrates competency in treating patient information as confidential	
4. Demonstrates good baby handling and positioning skills	
5. Demonstrates ability to explain the screening test to parents/caregivers and answer common questions	
6. Demonstrates competency in handling and operating the screening equipment (If required - entering patient information into the screening unit and scrolling through existing records)	
7. <u>AABR:</u> Demonstrates competency in preparing the baby's skin for electrode placement, and placing the electrodes so as to obtain minimum impedance levels <u>OAE:</u> Demonstrates competency in proper probe tip selection and obtaining a tight fit of probe tip in the infant's ear canal	
8. Demonstrates competency in following the screening protocol	
9. Demonstrates ability to sensitively communicate the screening results to the parents/caregivers, using proper explanations	
10. Demonstrates ability to communicate the need for follow-up (if necessary) and provide information regarding the follow-up process	
11. Demonstrates competency in all administrative tasks required by the programme (e.g. completing test forms, recording results in appropriate areas, database capturing, follow-up registers, etc.)	

12. Demonstrates ability to address commonly asked questions by parents/caregivers, and knowledge of where to refer if unable to answer questions	
13. Demonstrates competency in prioritising infants to be screened based on context specific factors such as infant state, age and estimated discharge time	
14. Demonstrates basic troubleshooting abilities with the screening unit	
15. Demonstrates an understanding of various options for intervention in SA, and long term implications of hearing loss if there is no screening and intervention	

Date: _____

Screener signature: _____

Supervisor signature: _____