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# Factors Influencing the Implementation of New-born and Infant Hearing Screening Programmes at Primary Health Care Clinics in South Africa

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### **Authors' contributions**

*This whole work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## ABSTRACT

**Purpose:** This study aimed to explore possible factors which may influence the implementation of new-born and infant hearing screening programmes at Primary Healthcare Clinics in South Africa at Maternal Child Woman's Health (MCWH) immunisation clinics.

**Participants:** Thirty primary healthcare immunisation clinic managers/acting managers were interviewed in two South African sample groups, in the North West province (NW) and Gauteng (GP).

**Design:** An exploratory, non-experimental, qualitative research design was employed incorporating both quantitative and qualitative information within the two sample groups.

**Methods and Materials:** An interview using a questionnaire was administered with primary health care (PHC) clinic nursing manager/acting manager, placed within the identified sites. The questionnaire encompassed areas such as work contexts, hearing screening contexts and information management systems, as well as quality control measures in place at these clinics.

**Data Analysis:** Content analysis was used to code emergent themes into specific categories. Frequency calculations of the emergent themes were conducted and results described qualitatively.

**Results:** Findings revealed high willingness by clinic managers to have hearing screening form part of their workload; but with attendance to important barriers that were identified.

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These barriers included resources such as ear and hearing knowledge constraints; human resources, equipment; and budgetary constraints. These findings have important implications for early hearing detection and intervention (EHDI) in PHC.

*Keywords: Health professions council of South Africa; early hearing detection and intervention; primary healthcare immunisation clinics; interview.*

## 1. INTRODUCTION

Early hearing detection and intervention (EHDI) services within the South African context are in their infancy with very little evidence for their efficacy and applicability [1]. A paucity of scientific data as well as published studies into EHDI implementation in the South African context exists [2,3]. Additionally, the obligation of legislation mandating EHDI is deficient [4], where primary alarms to possible hearing loss rest with the caregiver, where their concerns may be linked to speech-language delays, atypical behaviour or otitis media complications [5].

Internationally, advocating for universal new-born hearing screening (UNHS) as a means of EHDI has been acknowledged as a measure of child health care best practice [6], and has been underscored as the preferred approach for hearing healthcare in private and public sectors of health care management [7,8]. Locally, these health care sectors have ratified early intervention principles as they pertain to EHDI [9]. One of the important principles pertaining to EHDI include a recommendation for diagnosis of hearing impairment with early intervention services implemented by six months of age internationally [10], and by a maximum of eight months of age in South Africa [9]. The success of these principles under any context relies on the feasibility of implementation; such that there is efficient correlation between theory and practice.

Although South Africa has a position statement [9] on EHDI; feasibility of the implementation of this position statement remains in the research ambit, even though this position statement is grounded on international standards which have proven efficacy. The feasibility and benefits of EHDI programmes throughout the United States, for example, are well published [11,12]. Many developed countries [10] and some developing countries [13,14] have in fact promulgated hearing screening policy based on Joint Committee on Infant Hearing Screening (JCIH) principles [13]. Evidence suggests that most developing world contexts have; for various reasons, not formally recognized the advantages UNHS offers and have thus not legislated any hearing screening protocols [14].

Some reasons cited for the lack of systematic and standardized EHDI in most developing world contexts; although unclear and complex, are arguably understandable when one considers contextual factors. One can assume that additional burdens often endemic to regions like Sub-Saharan Africa, including poverty [15] and the burden of life-threatening diseases such as human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) and tuberculosis [16] have an influence in terms of prioritization of resource allocation. In these contexts, hearing impairment presents with comparatively less urgency rendering implementation of EHDI to be less of a priority [6]. Furthermore, challenges relating to human resources, equipment, as well as knowledge base of the personnel involved contribute significantly to these barriers; hence the importance of the current study. In South Africa, parallel private and public systems exist, with the public system serving the vast majority of the population; and it is this system that is chronically underfunded and

understaffed. The wealthiest 20% of the population uses the private system and are far better served; with at least 80% of doctors working in this sector. Neither of the systems has hearing screening forming part of the compulsory package of care. In some private sector institutions where it is implemented, the costs are borne entirely by the parents either directly or via their medical insurance.

Even within developed world contexts, EHDI's sustainability is challenged when implemented exclusive of consideration of contextual relevance [6] and appropriate collaboration between relevant stakeholders [17]. EHDI programme efficacy and sustainability is only achievable if the setting in which it is to be implemented is considered specifically [6]. The tenet that EHDI programmes must be contextually relevant is even more crucial in the developing world context, where the level of additional challenges these regions face is considerable compared to developed world environments [18].

If inroads are to be made towards actualising the ultimate aim of reducing disability through application of a contextually specific UNHS programme, with appropriate combination of theoretical and logistical constructs, key issues within the specific screening context must be identified and explored. The current study aimed to explore possible factors which may influence the implementation of new-born and infant hearing screening programmes at Primary Healthcare Clinics in South Africa.

## **2. METHODOLOGY**

### **2.1 Primary Aim**

The aim of the current study was to explore possible factors which may influence the implementation of new-born and infant hearing screening programmes at Primary Healthcare Clinics in South Africa; by looking at specifically:

- Community-based primary healthcare workers' knowledge base pertaining to hearing impairment
- Community-based primary healthcare workers' perceptions and attitudes towards hearing impairment
- Community-based primary healthcare workers' willingness to conduct hearing screening

### **2.2 The Sample**

Thirty primary healthcare nurses were included in the study and they were recruited from primary healthcare immunisation clinics located within the district MCWH Cluster construct, where all services rendered are at a healthcare level one. Within the MCWH cluster, community nurses and lay volunteers provide services including implementation of immunization programmes, where yield (actual immunizations generated out of the possible population in the area) is reported to be 91.8% in Gauteng and 71.4% in the North West [19]. More specifically, these mobile and fixed clinics may be described as predominantly outpatient facilities, which incorporate the specific targeted population of infants requiring immunisations at six, ten and fourteen weeks, nine and eighteen months, and five years. For the purposes of the current study, in order to facilitate improved control over extraneous variables, only nurses stationed at fixed non-mobile clinics were included.

Participants were drawn from two provinces in South Africa; namely Gauteng and North West provinces. These two provinces are considered to generally differ demographically in terms of socio-economic development based on the deprivation index as estimated from the Community Survey [20], with the North West population group considered to be more disadvantaged than that of Gauteng province [19]. Socio-economic indicators are considered to measure some of the most important health determinants within a primary healthcare approach [19]. The overall differences between North West and Gauteng provinces were aimed at facilitating a rural-urban divide, and these were thought to be useful for assessing hearing healthcare outcome determinants within the context of this study by the current researchers.

### **2.3 Sample Size, Distribution and Sampling Procedure**

Thirty primary healthcare clinic nurses in charge of 30 primary healthcare immunisation clinics within the North West and Gauteng provinces (15 per province) were recruited according to accessibility and according to the district demographic classification [19]. This non-probability purposive participant recruitment strategy was adopted to ensure that the deprivation index difference in profile between the two provinces was maintained. These nurses were either officially within the position of Operations Manager or Acting Operations Manager or heading the clinic at that time if the incumbent was unavailable for the interview. The interview location (for all interviews including those conducted for the pilot project) was the participant's immunisation clinic.

Within this selected demographic location, convenience sampling of appropriate primary health care clinics occurred, where the conduction of immunisations to infants at 6, 10 and 14 weeks was a prerequisite.

### **2.4 Participants**

#### **2.4.1 Participant selection – inclusion/exclusion criteria**

For participants to be included in the current study, the following criteria had to be met:

1. The health care nurse to be interviewed was required to be in charge of the individual clinic's overall functioning. A main reason for selecting the clinic manager as interviewee was that being at the helm implies insight as to the detailed workings of the particular clinic in question.
2. Health care nurses to be interviewed were required to be located within Gauteng and North West provinces in designated proportions as defined under sample selection.
3. Each participant needed to be conversant in English as the interviews were conducted in English.

### **2.5 Test Protocol**

#### **2.5.1 Material and apparatus**

The following materials were used to obtain data for the current study:

#### *2.5.1.1 Participant information sheets and consent forms*

An information sheet(s) describing the purpose of the study and the process involved was presented to each participant prior to initiation of the interview.

#### *2.5.1.2 Interview schedule*

The interview schedule and questionnaire used was structured where most questions presented were factual and closed-ended. These were supplemented by several open-ended questions to enable documentation of free thought processes which the researcher transcribed verbatim. The questionnaire was adapted from a self-administered questionnaire previously used in a study conducted in a collaborative effort by EHDI South Africa, the Centre for Deaf Studies and Deaf Education, the University of Pretoria and the University of the Witwatersrand [12]. The interview schedule used in the face-to face interviews, consisted of the following sections:

- Demographic information
- Work context
- Hearing screening context
- Information management and quality control

#### *2.5.1.3 Tape recorder*

A digital tape recorder (Sony ICD-UX81F) was used to record interviews to increase the accuracy of the responses documented by cross-checking the verbatim transcription of responses. Using a tape recorder to verify transcriptions improves the quality of the data collection and reliability and validity of the transcription process [21].

## **2.6 Procedures**

Ethical clearance (clearance certificate number M091040) to conduct the study was secured from the University of the Witwatersrand's Human Ethics Committee (Medical) prior to the study being conducted. Further approval for the study was obtained from the Gauteng Province and North West Province Directors: Policy, Planning and Research divisions; from the respective province director; as well as verbal permission from the specific sub-district divisions to ensure ease of access to the respective clinics. Thereafter, permission was obtained from individual immunisation clinic managers or their assigned deputy so as to ensure the participants' autonomy.

Data was collected via verbatim documentation of respondents' answers and audio-taped recordings of interviews which were transcribed.

The time frame for administering the structured interviews spanned a maximum of one hour per interview.

## **2.7 Data Analysis and Statistical Procedures**

As the research design was specifically qualitative in nature, direct cause-effect relationships could not be inferred [22] from the attribute variables associated with the different socio-

economic demographic variables of the provinces (North West and Gauteng) from which the target participants were derived.

The data obtained were analysed using content analysis [23] where transcriptions were evaluated to determine and code the emerging themes [23,24]. Quantitative data analysis, through the use of frequency calculations were condensed into tabular format for ease of frequency comparison. Specific comparisons were made as follows:

The first focus of the investigation aimed to determine and explore the possible concomitant personnel associated factors considered to influence the implementation of new-born and infant hearing screening (N/IHS) programmes. Questionnaire items addressed the four personnel associated factors considered to influence N/IHS as follows:

- Community-based primary health care workers' reported knowledge of hearing impairment as documented by Olusanya [6] to possibly impact EHDI implementation.
- Community-based primary health care workers' reported knowledge on ear infections in children: Otitis media and its associated hearing loss is specifically targeted within the Primary Health Care Package's strategic initiative, where the IMCI's key objectives are to reduce mortality and morbidity (inclusive of disability) from the principle causes of childhood illness [25,26]. It was thus deemed relevant to specifically pursue investigation of primary healthcare workers' knowledge pertaining to otitis media and its sequellae, where training in Integrated Management of Childhood Illness (IMCI) protocols emphasises the importance of detection and management of otitis media [25,26].
- Nursing training: Community-based primary health care workers' perceptions and attitudes towards hearing impairment are thought to possibly affect the efficacy of healthcare procedure implementation [27,28]. As inferred from the WHO's recognition that hearing impairment has been a neglected disability in the public health field with the need to educate communities as well as health personnel, training pertaining to ear related issues within the South African context, may be directly related to interviewee's knowledge on ear related issues. Interviewee reports on their training were thus evaluated pertaining to (a) ears in infants (under a year old), (b) ear problems in infants (under a year old), (c) and hearing problems in infants (also under a year old) was felt to be of value as a possible influence on the status of interviewee expression of (a) his/her knowledge, perceptions and attitudes towards hearing impairment and (b) willingness to conduct hearing screening in children. Binary questions were posed in this regard.
- Community-based primary health care workers' reported willingness to implement new-born/infant hearing screening procedures: Willingness to conduct procedures may have been based on the healthcare workers' attitudes towards hearing impairment, which is thought to possibly affect the efficacy of health care procedure implementation [27,28].

Frequency calculations were immediately conducted on straight-forward binary answers. All non-binary responses were transcribed verbatim where content analysis was applied to identify emergent themes. Frequencies of emergent themes were calculated per province and per sub-district. Further qualitative descriptive analysis was conducted in reference to

the socio-economic demographics of the particular region in question positioned against its comparative counterpart as defined on the Community Survey deprivational index [19].

Content analysis was applied to all responses transcribed verbatim where frequencies of emergent themes were calculated. Further qualitative descriptive analysis was conducted in reference to the socio-economic demographics of the particular region in question [19].

## 2.8 Reliability and Validity

In order to ensure research reliability in the current research study, controls were exercised pertaining to participant variables, parameters pertaining to the questionnaire used to obtain data and the interview procedures employed. Over and above conducting site observations; utilising an independent rater during data analysis; a pilot study was also conducted to ensure reliability and validity.

In order to validate the questionnaire and protocol used, a pilot study was conducted prior to the main research project. Pre-test administration of the research instrument on three nursing immunisation clinic managers that shared target population criteria and this allowed the researcher to determine validity and reliability by identifying flaws in the research process e.g. ambiguous questions and statements, leading questions, biased questions, timeframes associated with the interview process, and researcher bias [21]. All methodological processes and procedures followed were those of the main study. These pilot study participants were not included in the sample for the main study.

## 3. RESULTS AND DISCUSSION

The aim of the current study was to explore possible factors which may influence the implementation of new-born and infant hearing screening programmes at Primary Healthcare Clinics in South Africa.

### 3.1 Community-based Primary Health Care Workers' Knowledge of Hearing Impairment

The most prevalent theme identified by 19 respondents (63.3%;  $N=30$ ) in response to the direct question, "What is your knowledge on hearing impairment in children..." are revealed in Table 1 below.

**Table 1. Themes identified regarding participant knowledge of hearing impairment (in infants  $\leq$  1 year) ( $N=30$ )**

Theme	Participant number (%)
Causality e.g. ear infections, trauma	13.3
How to test	63.3
Interview Caregiver regarding hearing impairment	20
Child neglect	3.3
How hearing loss shows itself, how children respond to the world	13.3
Can't think of anything/don't know	23.3

*Note. As respondents may have offered more than one alternative, frequency calculations may not be equal to 100%*

As depicted in Table 1, a large majority (63%) of the sample believed they had sufficient knowledge on “how to test” for hearing loss, with only 13.3 % believing they have sufficient knowledge on causes of hearing loss in this age group.

Of significance was the lack of objectivity as well as standardization of the currently used hearing screening protocols in use at these PHC clinics. The procedures discussed by respondents as being used consisted of a combination of non-standardized noise-makers such as the use of rattles and/or bells and/or finger clicking and/or clapping and/or cup and spoon knocking and/or pens knocked against a surface. Speech stimuli were sometimes used as an assessment technique. The use of these outdated and non-objective and non-accurate measures should no longer be common practice as advances in technology such as the use of otoacoustic emissions (OAEs) and automated auditory brainstem response (AABR) is a standard protocol within this population. Furthermore, measures used should ensure early and accurate identification of hearing impairment; with minimal false positives – for efficient use of the limited resources available. This is particularly important in this context where a very small minority of participants were knowledgeable about causes of hearing impairment; meaning that identification based on risk-factors would also not be a reliable back-up strategy.

Of the respondents who exhibited knowledge of causes of hearing loss; all identified the importance of early intervention of otitis media as they believed complications of untreated otitis media include hearing loss. Where caregiver interviews were raised as important knowledge base one respondent related the caregiver interview as important from a traditional healing point of view, where certain traditional methods were considered to aggravate ear status, such as insertion of breast milk into the ear canals of infants if an ear problem was suspected by the parent.

Notwithstanding the above targeted area of investigation into concomitant personnel associated factors, it was interestingly a separate question in reference to perceived barriers to a hearing screening programme that revealed further respondent knowledge about hearing impairment and screening for hearing impairment (reflected in Table 2).

**Table 2. Factors which may negatively impact a hearing screening programme (N=30)**

Factors	Totals (N=30) %		
	Yes	No	Perhaps
Shortage of personnel involved with direct patient treatment	76.7	20	3.3
Shortage of administrative personnel	30	70	0
Shortage of appropriate equipment/hearing screening equipment	100	0	0
Equipment/hearing screening equipment failure or breakdown	73.3	13.3	3.3
Noise in hearing screening environments	80	16.7	3.3
Lack of awareness of other medical personnel	66.7	30	3.3
Lack of awareness in parents	80	13.3	6.7
Lack of willingness in parents	50	46.7	3.3
Lack of parent education	73.3	26.7	0
Cultural aspects e.g. cultural beliefs pertaining to disabilities and ancestral influence	53.3	40	6.7

*Note. As respondents may have offered more than one alternative, frequency calculations may not be equal to 100%*



It is important to note that 76.7% of respondents saw the need for additional staffing as necessary to conduct the clinical aspects of a hearing screening programme. This demonstrates relative insight as to the need for increased time required to screen each patient. In addition, 70% did not foresee the associated administration to unduly tax administrative staff, which may be reflective of reduced insight into effective hearing screening service provision, where strict quality and administrative controls are, required [9].

All respondents recognized the necessity for hearing screening equipment and just over 73.3% acknowledged the need for good equipment maintenance; contradicting findings pertaining to hearing screening methods currently utilized within these PHC clinics, where no mention was made of specific audiometric clinic equipment needs such as tympanometers or oto-acoustic emissions screeners.

Another important finding was that the majority (80%) of respondents regarded noise as problematic to implementation of an effective hearing screening programme; with another (80%) recognizing the need to educate parents, (50%) citing the lack of parental willingness as a cause for concern, and (53.3%) citing parental cultural beliefs such as ancestral influence on the health outcome to be of importance as an obstacle to effective hearing screening.

Surprisingly, most (76.7%) considered issues pertaining to parental willingness, parental education and parental cultural beliefs as surmountable through adequate parental education. This reflects on intrinsic knowledge of the important role parents play in effective hearing screening implementation and where parents are to be included as part of the family-centered approach [7,9].

The importance of early referrals to specialists and to whom to refer was also an area considered to be reflective of inherent respondent knowledge with regard to certain aspects more so than others. This is exemplified where the majority of respondents (25) (83.3%; N=30) made referrals on first suspicion of the presence of a hearing loss, but only 9 respondents (30%; N=30) referred infants to the relevant Audiologist/Speech Therapy and Audiology Department.

Lastly, in response to the question on the respondents' perception of hearing impairment, a respondent mentioned the hearing impaired person's perceived sense of isolation, as not many people are able "to sign". This further links to the respondent's knowledge-base, where hearing impairment, in this instance, appears to be associated with profound hearing loss alone where the milder losses of hearing appear to be discounted.

### **3.2 Community-based Primary Health Care Workers' Knowledge on Ear Infections in Children**

As otitis media and its associated hearing loss is specifically targeted within the Primary Health Care Package's strategic initiative [25,26], it was deemed relevant to specifically pursue investigation of primary healthcare worker's knowledge pertaining to otitis media and its sequelae and describe the themes identified.

Specifically, the themes identified included knowledge pertaining to how one observes the child's physical and behavioural manifestations of ear infections, how ear infections occur and how ear infections are treated. The last-mentioned was further categorized into treatment by parental education, drug therapy, a general statement on how to treat ear

infections or advise parents regarding management, with the last theme identified as the need for re-assessment.

In overview, 12 respondents (40%; N=30) mentioned how to evaluate the presence of an ear infection, specifying aspects such as observing wet versus dry ear canals, ear discharge, assessment of the presence of foreign bodies, bulging tympanic membranes, detection of a reduced light reflex, and the presence of fever. Six respondents (20%; N=30) referred to the importance of infant behavioural observation including the scratching and pulling of ears, and the importance of differential diagnosis e.g. teething.

The next category of note was defined as how ear infections occur. Six respondents (20%; N=30), defined otitis media having occurred as a consequence of milk having entered the infant's ear whilst in a prone position (referred to as prop-feeding). Further responses pertaining to disease related processes, mentioned by 5 respondents (16.7%, N=30) included one respondent specifically having related the infection to HIV/AIDS and one respondent having mentioned ear infections arising from children swimming in contaminated pools. Three respondent (10%; N=30) commented on the dangers of the disease occurring through earbud usage.

Several respondents referred to specific complications of otitis media such as inner ear secondary infections, tympanic membrane perforation, with some commenting specifically on the chronic manifestation of otitis media with hearing impairment as a complication should treatment be reduced.

Considering the high incidence of otitis media in this population; current findings highlighted a need for more detailed and comprehensive training for PHC nurses to ensure that reversible hearing impairment due to otitis media is accurately identified and effectively treated to prevent it from causing permanent damage; including delayed speech-language development due to recurrent otitis media.

### **3.3 Community-based Primary Health Care Workers' Perceptions and Attitudes towards Hearing Impairment**

Below is a reflection of the themes generated from the open-ended question, "What are your personal views about hearing impairment?"

Twelve interviewees (40%; N=30) expressed direct views on the difficulties associated with hearing loss with a discernable overall lack of detail as exhibited in respondents' comments such as, "It's very bad, unbearable", "It's painful and stressful" and "It's heart breaking" as well as "It's not good as it has its own problems", "It's a hard things, it's important to communicate and understand", "It's less recognised and we need to make people aware, the community and health personnel need more education", with another having stated that hearing impairment "is a hard thing, it's important to communicate and understand". One respondent also commented that hearing impairment could make a person feel "paranoid with no direction", suggestive of the difficult psycho-social dynamics of hearing impairment as documented by Northern and Downs [29] and Hutt and Rhodes [30].

Further themes elicited, as expressed by a total of 10 respondents (33.3%; N=30), related to the importance of early detection with the necessary early referrals to specialists to reduce the negative repercussions associated with hearing impairment. This alludes to the well-

expressed silent epidemic of hearing loss, where hearing loss often goes unnoticed in developing countries [18].

The remaining themes reflected answers of a more procedural nature with details pertaining to how hearing loss is tested (13.3%; N=30), the importance of testing (10%; N=30), and the importance of including such a testing regimen as part of the immunisation protocol (10%; N=30). A further 4 (13.3%; N=30) attested to the importance of referring such patients to appropriate outside facilities. Five respondents (16.7%; N=30) referred to their lack of knowledge on how hearing was tested, one of these specifically having mentioned the need for improved education on how to test for hearing impairment to prevent children slipping through the system where their hearing impairment remaining undetected.

### **3.4 Community-based Primary Health Care Workers' Willingness to Conduct Hearing Screening**

Below is a reflection of the themes generated from the open-ended question, "Would you be willing to implement infant hearing screening to coincide with the infant immunisation schedule?"

A total of 28 respondents (93.3%; N=30) expressed their willingness to implement hearing screening and 27 of these stated they would be able to do so to coincide with the infant immunisations schedule. Such idealism prevailed in comments such as "Saving one life is the most important thing, so even if it takes longer, we will do it", "We may be able to prioritise better so we don't do what we are not supposed to be doing", "Even if it takes 10 minutes extra per baby, we'll do it because it's going to help", "Nurses are flexible as far as change is concerned...we are used to extra things being added without extra staff" and "It's good to get to lots of babies", "If it's supposed to be done we'll do it because it's going to help".

Of the participants who were not willing to implement infant hearing screening as part of their clinic, one response referred to the current staffing not being adequate enough to do so, and the second stated that the tertiary hospital patients were referred to was adequate enough in dealing with such screening. Of note is that one of the 28 respondents was willing to implement hearing screening as part of the PHC clinic but not to coincide with immunisations and stated that there were too many children to see to and that two teams would be required to work with the infants simultaneously, one to conduct immunisations and one to conduct hearing screening. This comment is felt to be realistic and insightful in relation to the logistics involved in hearing screening where high yield is the aim [9,10].

The 27 overall affirmative responses (90; N=30) to conduct hearing screening to coincide with the PHC facility's immunisation schedule had added specified provisions, 15 (55.5%; N=27) of which were in reference to increased staffing, 8 of which (29.6%; N=27) were in reference to the need for adequate staff training. Such findings are consistent with the WHO data on the need to increase knowledge and skill amongst primary healthcare workers in developing world contexts. Lastly, seven of the 27 affirmative responses (25.9%; N=27) specified provisions in reference to provision of the correct equipment. Just 2 respondents (7.4%; N=27) commented on the need for improved facility structure by provision of a quieter testing area which was not currently available.

These findings are useful in terms of planning for EHDI as willingness to conduct screening is a significant factor within the South African context where the numbers of audiologists;

who are currently the main personnel engaging in EHDI, are minimal. A very small number of audiologists per patient population is a real challenge; and a further challenge is that this small number is split between the public and private sector; with minimal to none post allocation in PHC. This therefore indicates that nurses training in EHDI could be the best way forward in terms of successful implementation within this context.

#### **4. CONCLUSION**

Because early hearing intervention services, inclusive of early identification, are considered the foundation for attaining most favourable results in infants with hearing loss [4]; current findings are thought to be important in contributing toward context specific and context relevant implementation in South Africa. The context where the current study was conducted is the generally less resourced public health care sector within South Africa's developing world context, which is the option upon which 85% of the population relies [4] – hence, current findings have relevance for the majority of the population.

Fundamental evidence from the current study relate specifically to the South African primary health care immunisation clinic context. The main objective of the current study was to explore possible factors which may influence the implementation of new-born and infant hearing screening programmes; with a specific focus on the personnel's knowledge about and attitudes towards hearing impairment, and their willingness to perform hearing screening. Based on the emergent findings, it was evident that implementing the HPCSA's EHDI clinic guidelines in primary health care settings does not appear feasible at this point in time because of the overriding barriers revealed, although the willingness to conduct the screening was a hugely positive and encouraging finding within the PHC immunisation context. The identified barriers; which included reduced clinic infrastructure and resources and reduced staff complement and training, preclude successful HPCSA [9] EHDI implementation despite the present assets identified. Such assets included overall respondent willingness to implement formalised hearing screening as part of the PHC immunisation schedule. Other assets included patient return rates for immunisation, highlighting the favourable context the immunisation programme offers in terms of high patient yield, regarded as fundamental in a UHS programme [31]. An overriding implication from the current findings was that before HPCSA 2007 protocol implementation is considered, available funding should be investigated to establish the financial support that will be required for HPCSA EHDI implementation at a clinic level. Financial commitment from the state for systematic planning and implementation of early intervention programs is required as barriers identified can be alleviated by such commitment. Furthermore, training of nurses in hearing screening as the personnel who will be conducting the screening at this level would need to be undertaken as part of the continued professional development initiatives.

Despite IMCI and Road to Health Chart inform of (RtHC) milestone hearing screening protocols having been defined for endorsement at a central government directorate level, protocols for hearing screening applied at the clinics under investigation were varied and characterized by a lack of consistency and international standardization. Such variation was noted in terms of hearing screening timing as well as the hearing screening administered. Specific differences in adherence to current centralised hearing screening IMCI and RtHC milestone protocols were also present. It is thus recommended that these differences be investigated according to (a) in terms of policies recommended centrally versus actual district applications, specifically as they impact on the hearing screening protocols currently in use in the PHC clinic setting, and (b) other contributing factors, such as possible ambiguity in terms

of appropriate protocols to be applied. Within the last-mentioned, although the IMCI and RtHC protocols appear adjunctive, where RtHC protocols appear to be an attempt to capture the population inclusive of babies that do not have URTI or otitis media type symptoms, DoH rationale appears scant with little detail accessible in describing whether this is an adjunctive method to infant health care. Further exploration into the possible adjunctive nature of the IMCI and RtHC processes is thus recommended as a basis to fine-tune and render more effective the DoH hearing screening processes currently in place.

The possible concomitant personnel associated factors that may influence hearing screening may relate to district infrastructural and budgetary support inequities [32]. Exploration on whether such challenges in financial and infrastructural support influence staff morale and emergent attitudes in PHC staff is recommended as staff willingness to implement hearing screening directly impinges on hearing screening programme implementation and its associated outcomes.

As staff training may also impinge on PHC staff attitude and willingness to conduct hearing screening as part of the immunisation programme, especially with regard to gaps in knowledge as it pertains to hearing impairment in general detected across the sample, further exploration of staff training on hearing impairment is recommended. Such exploration is recommended of undergraduate training prior to diploma or degree qualification, compared to PHC in-service training. In this way, the well-recognised need to provide staff improvement in health care education may be addressed in a defined and structured manner, where knowledge base gaps can be systematically addressed to effect improvement in PHC hearing service delivery outcomes.

Finally a cost to benefit ratio projection would prove useful in calculating the burden inherent in late or non-identification and non-intervention of infants with hearing loss. It is recommended that a component in this costing exercise include a cost comparison of HPCSA [9] recommended guidelines for clinic based hearing screening to the current hearing screening process in use. Aspects for costing consideration and exploration include:

1. Equipment, inclusive of provision of an appropriate quiet area for infant hearing screening.
2. Infant record documentation, statistical registers inclusive of electronic based systems.
3. Staff complement, training, and work distribution. The current study revealed that adding the task of hearing screening to current clinic duties would not be realistic in terms of the time available within the clinic day to do so. It is thus suggested that given the nature and time frames usually involved in hearing screening, alternatives should be investigated such as the provision of additional supportive staff (with the necessary training) who's tasks are geared specifically towards conducting hearing screening activities.

Current findings highlight the importance of implementation of EHDI as an integrated part of infant health care service provision where coverage can be optimized; such as within the PHC immunization programme as advocated by Olusanya and Okolo [31], with careful addressing of the identified barriers within this context. These findings must be interpreted within the identified methodological limitations of the study. Because of the qualitative nature of this research with its reduced sample size, it is recommended that the current study be replicated in other provinces from a quantitative perspective, perhaps as a national self-administered survey in collaboration with DoH research directorates. This will facilitate better generalizability, with increased ability to draw causal inferences.

## **CONSENT**

All authors declare that written informed consent was obtained from all relevant authorities with ethical clearance obtained from the University's Ethics Committee.

## **ETHICAL APPROVAL**

All authors hereby declare that the study was examined and approved by the appropriate ethics committee and has therefore been performed in accordance with the ethical standards laid down in the 2012-2013 World Medical Association's Declaration of Helsinki.

## **COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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